Project Manual

PROJECT NO. DGS C-0251-0061 PHASE 001

Contract No. DGS 0251-0061 PHASE 1.1 – General Construction
Contract No. DGS 0251-0061 PHASE 1.2– HVAC Construction
Contract No. DGS 0251-0061 PHASE 1.3 – Plumbing Construction
Contract No. DGS 0251-0061 PHASE 1.4 – Electrical Construction

For

PennDOT – Development of New Stockpile, Dauphin County

COMMONWEALTH OF PENNSYLVANIA
DEPARMENT OF GENERAL SERVICES
HARRISBURG, PENNSYLVANIA

Josh Shapiro, Governor
Reginald B. McNeill II, Secretary

Seal

Professional's Signature: _____

Date: **FEBRUARY 23, 2024**

Mimar McKissick Architects & Engineers, LLC
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SECTION 010100

SUMMARY OF WORK

PART 1 – GENERAL

1.1 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 LOCATION

A. 9147 Allentown Boulevard, US 22, Grantville, PA 17028

1.3 PROJECT DESCRIPTION

A. Demolition of existing slab on grade, footings, utilities and appurtenances of former restaurant building
General site demolition of curbs, plantings and hardscape
Site regrading
Bituminous paving overlay and full depth replacement
Miscellaneous site improvements
Parking for fleet and personnel vehicles
New site lighting
Chain link site perimeter fencing, vehicle and man gates
New 850 SF Personnel Staging Building (office)
New 4,500 SF glulam-framed three-bay salt storage barn and adjacent liquid brine distribution facility
New 200 SF pre-engineered metal storage building
New PV array and support tracking rack
New EV electric vehicle charging station
Heat pump for heating and cooling of Personal Staging Building
Interior finishes

1.4 CONTRACT DURATION

A. The Construction Contract duration shall be **272** calendar days commencing on the date of the Initial Job Conference.

1.5 WORK INCLUDED

A. The Work of this Project consists of, but is not necessarily limited to, the following. Detailed requirements of the Work are described in the pertinent specification Sections and/or shown on the Drawings.

B. General Construction (.1) Contract:

1. Site demolition of existing slab on grade, footings, utilities, piping, grease interceptor and well pump and wiring.
2. Site improvements including paving, mill and overlay, striping, regrading, fencing and gates, guardrail.
3. Construction of new 4,500 SF glulam framed salt storage facility including all miscellaneous blocking and unistrut / allthread support framing for piping and all miscellaneous framing.
4. Construction of new 850 SF Personal Staging Building.
5. Construction of foundation for and provision of new 200 SF pre-engineered metal storage building.

6. Footing for support of new photovoltaic support rack.
7. Power operated gate, motors and controls.

C. HVAC Construction (.2) Contract:

Note: All HVAC Construction is at the Personnel Staging Building
1.New heat pump for heating and cooling
2. Interior ductwork air distribution system
3. HVAC controls and wiring
4. Grilles, diffusers, registers
5. Exhaust fans

D. Plumbing Construction (.3) Contract:

1. Water service piping from well to Personnel Staging Building
2. Electric water heater
3. Interior plumbing distribution piping
4. Plumbing fixtures and trim
5. Storage containers, pump and piping package for brine station including pipe roller supports.

E. Electrical Construction (.4) Contract:

1. New service from transformer to panel
2. Interior distribution panel and two exterior site panels
3. Interior and exterior site, lighting and power wiring and conduits, including all low voltage wiring and controls.
4. Low voltage wiring
5. Lighting fixtures for all buildings
6. Power outlets
7. Data jacks
8. Data racks and mounting
9. Site lighting with 25’ poles and fixtures
10. Exterior building mounted lighting
11. PV array for all Base Bids
12. EV charger station
13. Twist Lock outlets at the trucks parking and at the Salt building
14. Power to HVAC and pumps (well & brine tanks)
15. Power and low voltage control wiring for power operated gate

1.6 SPECIFICATION FORMAT

A. The Specifications for the work of the separate prime Contracts are bound in one volume. Technical provisions which apply to each prime Contract are included in the Divisions listed below:

B. General Construction (.1) Contract: Divisions 01 through 14 and Divisions 31, 32 and applicable Sections of Division 33

C. HVAC Construction (.2) Contract: Divisions 01, 23 and applicable Sections of Divisions 02, 03, 05, 07, 09, 25, 31, 32 and 33.

D. Plumbing Construction (.3) Contract: Divisions 01, 21, 22 and applicable Sections of Divisions 02, 03, 05, 07, 09, 25, 31, 32 and 33.

E. Electrical Construction (.4) Contract: Divisions 01, 25, 26 and applicable Sections of 02, 03, 07, 08, 31, 32, 33 and 48.

Note: The term Professional refers to the Architectural or Engineering firm retained by the Department to design and document the work of the Project, or the Professional's authorized representative. The term Professional may also refer to the Client Agency if the Project design was delegated to the Client Agency. Throughout the Specifications and Drawings wherever the terms 'A/E', 'Architect' or 'Engineer' are used it shall mean Professional.

1.7 WORK BY OTHERS

A. N/A

1.8 E-BUILDER CONSTRUCTION MANAGEMENT SOFTWARE

A. The electronic document repository to improve productivity and efficiency, and to streamline the process of construction management during all phases of design, procurement, award and contract administration. The Department and all Prime Contractors will utilize the e-Builder Enterprise Software Program (e-Builder) for all Work and administrative duties provided under this Contract. Any and all notifications, request, submittals, approvals, etc. between the Department, The Prime Contractors, the Professional, and/or the Construction Manager (if a CM is assigned to the Project) shall be through the e-Builder system.

1.9 QUESTIONS DURING BIDDING PERIOD

A. Direct all questions pertaining to the Project to the Project Professional utilizing the e-Builder Enterprise Software Program (e-Builder) as described in the Instructions To Bidders.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

SECTION 010300

BASE BID DESCRIPTIONS

PART 1 – GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions of the Construction Contract”, “Special Conditions”, and “Division 1 - General Requirements” form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SECTION INCLUDES

A. This Section includes identification of each Base Bid and description of the changes to be associated with each Base Bid.

1.3 DESCRIPTION OF SEPARATE BASE BIDS

A. GENERAL CONSTRUCTION CONTRACT (DGS C-0251-0061 PHASE 1.1)

1. Base Bid No. 1:

   a. Shall include all the work indicated on the Contract Drawings and described in the Contract Specifications except that work specifically called out as being part of another Base Bid.

2. Base Bid No. 2:

   a. Same as Base Bid No. 1, except add additional photovoltaic array scope as applicable to General Contract.

B. HVAC CONSTRUCTION CONTRACT (DGS C-0251-0061 PHASE 1.2)

1. Base Bid No. 1:

   a. Shall include all the work indicated on the Contract Drawings and described in the Contract Specifications except that work specifically called out as being part of another Base Bid.

2. Base Bid No. 2: Same as Base Bid No. 1.

C. PLUMBING CONSTRUCTION CONTRACT (DGS C-0251-0061 PHASE 1.3)

1. Base Bid No. 1:

   a. Shall include all the work indicated on the Contract Drawings and described in the Contract Specifications except that work specifically called out as being part of another Base Bid.

2. Base Bid No. 2:

   a. Same as Base Bid No. 1, except delete tank water heater and add instantaneous water heater.

D. ELECTRICAL CONSTRUCTION CONTRACT (DGS C-0251-0061 PHASE 1.4)

1. Base Bid No. 1:

    a. Shall include all the work indicated on the Contract Drawings and described in the Contract Specifications except that work specifically called out as being part of another Base Bid.

2. Base Bid No. 2:

    a. Same as Base Bid No. 1, except add additional photovoltaic array scope as applicable to Electrical Contract.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

SECTION 010400

COORDINATION AND CONTROL

PART 1 – GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SECTION INCLUDES

A. This section includes the on-site provisions that govern the performance of the work to complete this Project.

1.3 CONTRACTS - FOR THIS PROJECT CONSTRUCTION

A. DGS C-0251-0061 PHASE 1.1 General Construction (Lead Contractor)

B. DGS C-0251-0061 PHASE 1.2 HVAC Construction

C. DGS C-0251-0061 PHASE 1.3 Plumbing Construction

D. DGS C-0251-0061 PHASE 1.4 Electrical Construction

1.4 VISIT TO SITE

A. For access to the site during the bidding period contact the Client Agency site personnel with phone number listed below:

1. Client Agency Site Representative: Eric Silfies
2. Telephone Number: (482) 523-5983

B. Access to the facility during the bidding period will be restricted to a tour associated with the Pre-Bid Conference or other scheduled events.

1.5 UNIDENTIFIED HAZARDOUS MATERIALS (ASBESTOS, CHEMICALS, ETC.)

A. There are no hazardous materials expected to be encountered.

1.6 N/A

1.7 N/A

1.8 TESTING OF EQUIPMENT

A. After any equipment furnished under the contract and any permanent heating, ventilating, plumbing, drainage or electrical systems and equipment have been installed or modified, it shall be the responsibility of the Contractor to operate its equipment for a satisfactory period of time, as required by the Department for proper testing and instructing the operating personnel. Fuel, electricity and water required for proper testing of permanent equipment and for the period of instructing personnel, shall be paid for by the Contractor testing its equipment.

1.9 PROJECT PHOTOGRAPHS

A. All Prime Contractors shall take photographs on at least a weekly basis to document general progress of individual trades and work. All work areas shall be documented. Photographs shall also document differing site conditions or previously concealed conditions that may affect the work.

1.10 INSTRUCTIONS AND TRAINING

A. Refer to the General Conditions of the Construction Contract, as specified in the applicable technical portion of each specification for "Operations and Maintenance Instruction Manuals" and "Record Drawings" requirements.

B. Unless approved by the Department, training shall not be scheduled/conducted until Record Drawings, Operation and Maintenance Instruction Manuals, valve tag lists, equipment and piping system identification, and all software programming is complete.

C. Provide full on-site training and instruction to designated Commonwealth personnel given by competent manufacturer's authorized personnel thoroughly familiar with all technical and operational aspects of the installed items. Instructions are to cover operation and maintenance of all systems, equipment components and other items as specified and furnished under this contract. Instructional digital video recordings may be used to augment required instructions and training but may not be substituted for the in person on-site training. All on-site training shall be digitally recorded by the Contractor. The digital video files are to be turned over to the Client Agency.

D. Contractor shall provide an outline of the training and course content, which shall be submitted and accepted by the Professional and the Department prior to conducting training.

E. Conduct instruction and training during regular working hours. For training on complicated systems, allow at least one-half of the training time to be at and/or with the system equipment.

F. Provide additional training and instructions for all significant modifications and/or changes made under the terms and/or conditions of the manufacturer's and/or Contractor's warranty.

G. The Contractor shall maintain and submit a sign-in list that clearly documents all personnel attending the training.

1.11 PROJECT SIGN

A. Provide a Project Sign. Refer to the General Conditions of the Construction Contract.

1.12 REUSE OF MATERIALS

A. No removed materials or equipment shall be reinstalled in the work, unless so noted on the Drawing or in these Specifications.

1.13 GENERAL

A. All construction trailers, offices, equipment and materials required to be on-site shall be located as shown on the Drawings, or at the direction of the Department.

1.14 WORKING HOURS

A. The Contractor's available working hours shall be as per the ordinance of East Hanover Township and all other authorities having jurisdiction.

B. Work during different hours, or work on Saturdays, Sundays, State and National Holidays or overtime work, must have the Regional Director's or his designee's prior written approval. Work on these days if approved shall be at no additional cost or time to the Contract.

A. This shall not apply in those unforeseen isolated and/or emergency instances when a particular operation must be performed in a continuous sequence that extends the working day beyond the approved working hours. Coordinate with the Department in these instances.

B. The Department's failure to approve different working hours, weekend or holiday working hours, or overtime hours is not cause for a claim against the Department for delay or any added costs or time to the Contract.

E. Utility shut-downs required for tie-ins to existing systems shall be done in off-hours, weekends, and/or holidays to minimize the impact on the operations of the Client Agencies (and/ or surrounding buildings). These costs shall be anticipated and included in the Contractor's bid.

1.15 DELIVERY, STORAGE AND HANDLING

A. Prefinished materials shall arrive at job site in their original unopened cartons or other protective packaging necessary to protect finishes. Materials shall be stored in such packages until time of application. Flat materials such as panels shall arrive and remain on adequate support to ensure flatness and prevent damage.

B. Store all materials, equipment and bulk items prior to installation in clean, dry, well ventilated locations away from uncured concrete, masonry or damage of any kind. Waterproof tarpaulin or polyethylene sheeting must allow for air circulation under covering.

C. Coordinate storage location with the Department.

D. Refer to each section for specific delivery, handling and storage instructions of items specified.

1.16 PARKING

A. All parking is subject to prior approval of the Department and Client Agency.
B. On-site Contractor parking is available.

1.17 TRAFFIC

A. The Lead Contractor shall submit in eBuilder prior to the Initial Job Conference a construction staging and traffic plan for the project which minimizes the construction interference with the Client Agency's operation. This plan is subject to the Department's and the Client Agency's review and acceptance. This acceptance does not relieve the Contractors of their responsibilities regarding safety coordination, and adherence to all traffic laws and ordinances.

1.18 SUBSURFACE INFORMATION

A. Any available data concerning subsurface materials or conditions based on soundings, test pits or test borings, has been obtained by the Department for its own use in designing this Project. The Test Boring logs are incorporated into the construction contract as a Contract Document. However, the Geotechnical Report with all other exhibits is provided for information purposes only; it is not to be relied upon or included in the construction contract as a Contract Document. The Report is available to Bidders but the Bidders must agree and acknowledge that the information and recommendations in the Report are not warranted for accuracy, correctness or completeness, and is not incorporated as a Contract Document.

B. Test Boring logs reflect the conditions at the specific locations of each test boring only. The Contractor accepts full responsibility for any conclusion drawn with respect to conditions between test borings. Bidders shall therefore undertake to perform their own investigation of existing subsurface conditions. The Department will not be responsible in any way for the

consequences of the Contractor's failure to conduct such an investigation. Excavation for the Project is "Unclassified" as fully described in the Earthwork Section.

1.19 SITE FENCE

A. A site fence is to be provided at the areas of building construction to limit access to that portion of the site during construction and for security purposes. Additional fenced areas for material storage and laydown areas are at the Contractor's discretion. Fence shall be 6 foot tall galvanized chain link with panel base stands. Locked access control at Contractor's option. Client Agency staff shall be provided a key.

1.20 ENVIRONMENTAL QUALITY CONTROL

A. The Prime Contractor and its Subcontractors shall perform their work in a manner which shall minimize the possibility of air, water, land and noise pollution, in accordance with the General Conditions of the Construction Contract.

B. The name, address and telephone number of the Department of Environmental Protection Regional Office is furnished below. This office shall be contacted for waste disposal permits and for information concerning sites already approved for conducting waste disposal.

Southcentral Regional Office
909 Elmerton Avenue
Harrisburg, Pa. 17110-8200
(717) 705-4700

Counties: Adams, Bedford, Berks, Blair, Cumberland, Dauphin, Franklin, Fulton, Huntingdon, Juniata, Lancaster, Lebanon, Mifflin, Perry, and York

1.21 OFFICE FOR CONTRACTOR

A. Each Prime Contractor shall provide and maintain, at its cost, a suitable office on the premises, at a location shown on the Lead Contractor's accepted staging plan. The Contractor shall provide and maintain heating facilities and supply fuel for same in cold weather, and shall remove the office from the premises at completion of all work. Provide electrical, telephone and internet service.

1.22 DGS CONSTRUCTION COORDINATOR OFFICE

A. The Lead Contractor shall prepare a drawing of the DGS Construction Coordinator Office along with proposed arrangement of the Contractor's Office and construction staging area for the Department's approval. An electronic copy in .pdf format of the sketch plan is to be submitted through e-Builder to the Department within 7 calendar days of Effective Date of Contract or issuance of Letter of Intent whichever occurs first.

B. The Lead Contractor shall furnish, within five (5) days of the Department's approval of the Lead Contractor's drawing, a suitably finished mobile office of at least 800 square feet, including the necessary extension or provisioning of utilities and service lines required for its proper operation. The Lead Contractor shall clean this office at least bi-weekly, maintain and pay all utility bills, for the duration of the project, through the completion of all punch list items (unless directed otherwise by the Department). The Lead Contractor shall remove the office from the premises when directed by the Department. The office shall be suitably partitioned as directed by the Department and shall include:

1. Heating and Air-Conditioning
2. Screened and locking high security windows with bars, on at least two (2) sides, provided with adequate window blinds
3. Locking high strength steel, high security doors with high quality deadbolt door locks, complete with entrance steps and up to four (4) sets of keys
4. Lighting and electrical receptacles of suitable number and capacity
5. One (1) Restroom with water closet, and lavatory with hot and cold water and sanitary service.

6. A first quality mercury thermometer on outside of the DGS Construction Coordinator Office which records the high and low temperature for the day
7. The Lead contractor shall arrange for all electrical power hook-up/service (as well as water and sanitary, if required), and shall be responsible for all costs necessary to provide these services to the DGS Construction Coordinator Office (including monthly utility costs). A temporary electric service shall be ordered from the utility provider. If the temporary electrical service is not readily available from the utility provider, a temporary generator shall be provided and maintained (including fuel) until such time power can be established.)
8. The Lead Contractor to install (4) 9'x20' parking spaces directly adjacent to the DGS Construction Coordinator Office location. Specific location of parking spaces to be coordinated with Construction Project Coordinator.
9. Sanitary holding tank (to accommodate item 5 above) with capacity for three persons for a week, plus one weekly meeting with 12 persons. Tank shall be protected from freezing. Tank shall be emptied on weekly basis, more often if needed. Contractor shall arrange and be responsible for all costs necessary to provide this service to the field office (including all pickup and dump charges).
10. Domestic water holding tank with the same capacity as item 9 above (sized accordingly), to accommodate item 5 above.

C. Equipment: The Lead Contractor shall furnish for use with the DGS Construction Coordinator Office, the following items in the quantity indicated and remove same from the premises when directed by the Department. The Lead Contractor shall maintain all items in good condition and furnish all supplies (i.e., toner, paper, bottled water, drinking cups, toilet tissue) for the duration of the Contract. If any equipment fails, it shall be repaired or replaced by the Lead Contractor within twenty-four (24) hours of being notified by the Department.

The specified IT hardware/peripherals shall be compatible with the HP Revolve 810 EliteBook and include all required battery chargers, data cables (including HDMI), software, ect. to provide a fully integrated and functioning system.

1. __2__ Desk(s) with swivel chair(s)
2. __1__ Plans rack(s), plan rack shall include required quantity of plan sticks to fully utilize the plan rack
3. __1__ Clothes tree or closet with rod
4. __1__ Provide an all in one print/copy/scan/fax machine capable of producing 35 pages per minute double sided on 8-1/2"x11" and 11"x17". Machine shall be wireless capable and network capable and print/copy/scan/fax both in color and black and white
5. __5__ 500 count reams of 8-1/2"x11"20LB paper suitable for the copy machine provided.
6. __2__ 500 count reams of 11"x17" 20LB paper suitable for the copy machine provided.
7. __4__ Safety glasses
8. __1__ Fire Extinguisher
9. __1__ First-Aid Kit
10. __1__ Water cooler, with hot and cold taps
11. __3__ Filled 5 gallon water bottles per month for the duration of the project.
12. __2__ Office Trash cans

IT Hardware/Peripherals:

13 __4__ Computer monitor(s) - basis of design - Hewlett Packard ProDisplay P232 - 23"
14 __2__ Keyboard - basis of design - Hewlett Packard KU-1156
15 __2__ Docking station with all associated cables for connection of all peripheral devices to support the Hewlett Packard Revolve 810 - Basis of design - HP 2013 UltraSlim Docking Station.

16 __2__ Mouse - optical mouse with USB cord, dual button and scroll wheel – Basis of design - Hewlett Packard

17 __1__ 55” High Definition LED flat panel monitor with wall mount bracket and remote. Monitor shall be network/wireless capable, 120Hz, 1080P.

18 __1__ Wireless connectivity to the 55” High Definition LED flat panel monitor shall be accomplished with a wireless receiver and transmitter – Basis of design - ScreenBeam Mini2 wireless receiver (Catalog # SBWD60A01) and a ScreenBeam USB Transmitter 2 (Catalog # SBWD200TX02).

19 __1__ 4'x3' white marker board with (2) sets of markers of standard color.

20 __1__ 12 Month Wall Calendar - 20"x30" - Basis of design AT-A-GLANCE, Model #PM4-28-17 - for each calendar year or portion thereof of the project duration.

D. The DGS Construction Coordinator Office shall be equipped by the Lead Contractor with a Broadband Internet service and pay all connections/disconnection and monthly fees.

1. The Lead Contractor shall further provide Wi-Fi access utilizing WPA2 security. Options include cable modem, DSL, Satellite or similar service (dial up is not acceptable). The wireless access point should be positioned to provide sufficient coverage in the DGS Construction Coordinators Office space. The Lead contractor shall provide usernames/passwords for authorized wireless users as determined by the DGS Construction Project Coordinator.

   It shall be the Lead Contractor’s responsibility to ascertain the means by which the Broadband Internet source will be provided. Internet download and upload speeds of 100Mbs shall be provided at all times. The Internet source must be coordinated with the DGS Construction Project Coordinator to assure compatibility with the Department’s hardware/software requirements. Wireless access point shall be made fully operational and maintained by the Contractor

1.23 SANITARY FACILITIES

A. The Lead Contractor shall, at its cost, provide and maintain in a clean and sanitary condition, adequate and approved sanitary facilities in accordance with O.S.H.A. requirements. All facilities shall be screened against insects. When directed by the Department, the Contractor shall dismantle and remove these facilities and disinfect as required. Portable chemical toilets approved by the Pennsylvania Department of Health are acceptable. Under temporary field conditions, provisions shall be made to assure not less than one toilet facility is available.

1.24 SMOKING POLICY

A. Smoking and use of smokeless-tobacco, chewing tobacco, snuff, Vape machines and similar paraphernalia are strictly prohibited in all buildings.

1.25 CONCRETE AND EARTHWORK

A. All Contractors shall perform concrete work and earthwork required for their work, and shall comply with applicable Division 2, 3, 31, 32, and 33 sections. If any specification section contains language conflicting with requirements of applicable Division 2, 3, 31, 32, and 33 sections, the most stringent requirements shall prevail.

1.26 QUALITY CONTROL TESTING

A. Structural-related testing and inspections required to be performed by the Contractor(s) are listed in Section 014000 – Quality Control Testing Services. If Quality Control testing or inspections required appear in Section 014000 and in a technical section, the most stringent requirements shall prevail. If Quality Control testing or inspections required appear in a technical section and not in Section 014000, they shall be required as if specified in Section 014000. Conditions pertaining to Quality Control testing and inspections may appear in the technical sections. All testing herein is to be by the Contractor. Testing by the Department,

Quality Assurance Testing, is for the purpose of checking the results of the Contractor's Quality Control Testing. Testing is to be by the Contractor, unless specifically stated to be "by the Department" or required by Section 014010 – Quality Assurance Testing and Inspection Services.

B. Non-structural testing is in the technical specifications.

1.27 CADD FILE WAIVER

A. The Professional will make graphic portions of the bid drawings available for use by the Contractor by uploading files to e-Builder.

B. Electronic files shall be uploaded only after all construction contracts have been executed.

C. The files are provided as a convenience to the Contractor, for use in preparing shop drawings and/or coordination drawings related to the construction of this Project only. These files and the information contained within are the property of the Department, and may not be reproduced or used in any format except in conjunction with this Project.

D. The Contractor acknowledges that the information provided in these files is not a substitution or replacement for the Contract Documents and does not become a Contract Document. The Contractor acknowledges that neither the Professional nor the Department warrant or make any representation that the information contained in these files reflect the Contract Documents in their entirety. The Contractor assumes full responsibility in the use of these files and acknowledges that all addenda, clarifications and changes to the drawings executed as a part of the Contract Documents may or may not be incorporated in these electronic files.

E. The Contractor acknowledges that the furnishing of these files in no way relieves the Contractor from the responsibility for the preparation of shop drawings or other schedules as set forth in the Contract between the Contractor and the Department.

F. The electronic documents shall be stripped of the Professional's name and address, and any professional licenses and signatures indicated on the contract documents. Use of these electronic documents is solely at the Contractor's risk, and shall in no way alter the Contractor's Contract for Construction.

G. Disclaimer: The Professional and Department make no representation regarding fitness for any particular purpose, or suitability for use with any software or hardware, and shall not be responsible or liable for errors, defects, inexactitudes, or anomalies in the data, information, or documents (including drawings and specifications) caused by the Professional's or its Consultant's computer software or hardware defects or errors; the Professional's or its Consultant's electronic or disk transmittal of data, information or documents; or the Professional's or its Consultant's reformatting or automated conversion of data, information or documents electronically or disk transmitted from the Professional's Consultants to the Professional.

H. By the Contractor's or their subcontractor's use of the electronic files (e.g., AutoCAD files), the Contractor and their subcontractor waive all claims against the Department the Professional, its employees, officers and Consultants for any and all damages, losses, or expenses the Contractor incurs from any defects or errors in the electronic documents. Furthermore, the Contractor shall indemnify, defend, and hold harmless the Department, the Professional, and its Consultants together with their respective employees and officers, from and against any claims, suits, demands, causes of action, losses, damages or expenses (including all attorney's fees and litigation expenses) attributed to errors or defects in data, information or documents, including drawings and specifications.

1.28 DELEGATED DESIGN SERVICES

A. Performance and Design Criteria: Where design services or certifications by a design professional are specifically delegated to the Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated in the technical specification sections.

1. If criteria indicated in the technical sections are not sufficient to perform services or certification required, submit a written request for additional information to the Professional.

B. Delegated Design Services Submittals: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement signed and sealed by the responsible design professional registered in the Commonwealth of Pennsylvania, for each product and system specifically assigned to the Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.29 COORDINATION DRAWINGS

A. General:

1. Refer to the General Conditions of the Construction Contract regarding the preparation of Coordination Drawings and the responsibilities of all Prime Contractors. Any conflicts between or questions regarding the requirements in this Section and the requirements in the General Conditions should be brought to the attention of the Professional.
2. Refer to Technical Specification sections for specific Coordination Drawing requirements for mechanical and electrical installations. Other Technical Specifications sections may also identify requirements for Coordination Drawings.
3. The Prime Contractors shall indicate the value of this effort as a line item on the Schedule of Values.
4. Submission of Coordination Drawings shall be included as a milestone on the Construction Schedule. The General Contractor shall initiate this action and acquire the necessary dates from the other Prime Contractors as part of their overall scheduling responsibilities.
5. Coordination drawings shall be completed within (60) calendar days of the Effective Date of the Contract.
6. The Department's receipt of Coordination Drawings does not in any way constitute approval, or relieve the Prime Contractors of the responsibility to accurately coordinate and install their work.

B. Coordination Procedures:

1. The HVAC Contractor shall have the lead role in this process and shall initiate Coordination Drawings by producing background drawings in electronic format. Electronic drawing files will be available in e-Builder to all Prime Contractors. These background drawings shall include walls, partitions, structural elements, finished floor elevations, dimensions, ductwork, piping, conduit, system devices, associated equipment, etc.
2. Electronic drawings shall then be forwarded to the other Prime Contractors, one at a time, including the General Contractor, for inclusion, layout and interface of all relative equipment, material and penetrations associated with the Work.
3. Each Prime Contractor is responsible for the accuracy and completeness of all Coordination Drawings and shall review all other Prime Contractor's drawings so that there will be no interference and/or conflict with its portion of the work.
4. Upon completion of the preliminary Coordination Drawings, the HVAC Contractor shall schedule a coordination meeting with all Prime Contractors in order to resolve all interference issues. Altering structural elements, bearing elevations, established

dimensions, partition locations and ceiling/bulkhead heights or any other aesthetic effect is prohibited without the consent of the Professional.

5. Upon resolution of all interference issues, the Coordination Drawings shall be revised as required, and upon acceptance by all Prime Contractors, the HVAC Contractor will upload the final Coordination Drawings to e-Builder.

    a. Coordination Drawings shall contain a signature block for each Prime Contractor to provide signatures and dates indicating concurrence.

6. Coordination Drawings may be formulated and submitted in partial submittals to facilitate the construction schedule and sequence of work within the Project. This must be agreed to by all Prime Contractors and a priority of sequence must be established that has the concurrence of all parties, including the Department. Approval of partial sets of Coordination Drawings shall not relieve the Contractors of their responsibility for properly coordinating work appearing in subsequent submissions. Any revisions to subsequent work necessitated by such partial approvals shall be performed at no additional cost to the Department.

C. Coordination of Work:

1. Each Prime Contractor shall clearly show, and coordinate with the other Prime Contractors, the following:

    a. Arrange for pipe spaces, chases, slots, sleeves, and openings with general construction work, and arrange in building structure during progress of the Work, to allow for and facilitate distribution line and equipment installation.
    b. Coordinate installation of required supporting devices for ductwork, piping, and conduit, as well as sleeves, and other structural components, as they are constructed.
    c. Coordinate requirements for access panels and doors for HVAC, Plumbing and Electrical items requiring access where concealed behind finished surfaces.
    d. Coordinate electrical connections to equipment provided by all Contractors.
    e. Sequence, coordinate, and integrate installing materials and equipment for efficient flow of the Work. Coordinate installing large items of equipment requiring positioning before closing in the building.

2. Each Prime Contractor shall coordinate its construction operations with those of other Prime Contractors and entities to ensure efficient and orderly installation for each part of the Work. Each Prime Contractor shall coordinate its operations with other operations, included in different Sections that depend on each other for proper installations, connection, and operation. All Prime Contractors shall:

    a. 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.
    b. Coordinate installation of all components with other Prime Contractors to ensure adequate accessibility/clearance for required maintenance and service.
    c. Make provisions to accommodate items scheduled for later installation.

1.30 PERMIT CONDITIONS Coordination with East Hanover Township and the Dauphin County Conservation District.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

SECTION 01 31 00

SEQUENCE OF CONSTRUCTION AND MILESTONES

PART 1 – GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 GENERAL REQUIREMENTS

A. Before beginning work, the Contractor will be required to prepare a Critical Path Method (CPM) Project Schedule in consultation with the Department and all of the other Prime Contractors. The work must be carried out in full accordance with the schedule. The Contractor shall arrange to perform the work without any unnecessary interference with the Institution's operation.

B. The Project Schedule shall be developed in conformance with Article 8 of the General Conditions of the Contract, except as modified and/or augmented by this Section.

C. The detailed Project Schedule shall be developed in accordance with the Contract Documents, with the General Contractor being the "Lead" Contractor. The Lead Contractor shall furnish each Prime Contractor a draft progress schedule of the proposed prosecution of the Work under that Contractor's Contract within seven (7) calendar days of the Effective Date of the Contract or the date directed in the Letter of Intent to Contract. All Prime Contractors must provide the required scheduling data for their work to the Lead Contractor within seven (7) calendar days of the receipt of the Lead Contractor's draft progress schedule to facilitate the development of the CPM schedule. The submission of the Project Schedule, and all subsequent updates, shall be done in eBuilder utilizing the scheduling software native file as well as in PDF format (including all requested sorts and arrangements, utilizing color print). The attachments in e-Builder shall include all unlocked data files in the scheduling system used to develop the schedule. The start date on the schedule shall be the Initial Job Conference and end with the Contract Completion Date. The final fully integrated and detailed Project Schedule, accepted by all Prime Contractors, must be submitted in eBuilder for Professional and Departmental acceptance within thirty (30) calendar days of the Effective Date of the Contract or the date directed in the Letter of Intent to Contract.

D. The use of float suppression techniques, such as preferential sequencing (arranging the critical path through activities more susceptible to Client Agency or Department caused delays), special lead/lag logic restraints, zero total or free float constraints, extended activity times or imposing constraint dates other than as required by the contract, shall be cause for the rejection of the submitted project schedule or it's updates. The use of Resource Leveling (or similar software features) used for the purpose of artificially adjusting activity durations to consume float and influence the critical path is expressly forbidden.

E. Contractors shall also track submissions, ordering dates and delivery of materials in the Project Schedule.

F. A large sized copy of the accepted Project Schedule shall be maintained and posted in the DGS Construction Coordinators field office for access and monitoring of the progress of the work activities. At the direction of the Department, large sized copies of monthly schedule updates shall also be provided, posted and maintained in the DGS Construction Coordinators field office.

1.3 CRITICAL MATERIALS AND EQUIPMENT

A. The Contractor is cautioned that all necessary and required critical materials and equipment shall be ordered as quickly as possible, in order that the shipping will not delay the progress of the work or completion of the project.

1.4 CRITICAL ITEMS TO BE NOTED AS MILESTONES

A. Refer to the General Conditions, Article 8 regarding construction progress Milestones to be established by all Prime Contractors. The accepted Project Schedule shall also incorporate the milestones outlined in this specification section as well as additional milestones for interior construction and other work to ensure the timely completion of the project. The accepted Project Schedule shall have separate sections and consequently, separate unique Milestones for EACH building or area, Site Work, and Administrative/Technical Items such as but not limited to Commissioning activities. Additional sections may be added by the Department at time of schedule review and acceptance or throughout the project.

B. The Contractor shall include the following critical items as Milestones:

1. General Construction (.1) Contract:
   a. Slabs poured at Personnel Staging Building, Salt Barn and Storage Building.
   b. Enclosure of the Personnel Staging Building.
   c. Buildings shall be substantially complete prior to beginning site demolition and repaving.

2. HVAC Construction (.2) Contract:
   a. Enclosure of the Personnel Staging Building and turnover to permanent system heating or cooling.

3. Plumbing Construction (.3) Contract:
   a. Replacement and successful operation of well pump.
   b. Completion of Brine Tank Facility.

4. Electrical Construction (.4) Contract:
   a. Completion of underground utility conduit rough in.
   b. New electric service turnover.

C. The milestones noted in this section of the specifications apply to all the Prime Contractors. The HVAC, Plumbing and Electrical Prime Contractors shall adhere to the milestones and incorporate their work activities into the Project Schedule in order to achieve the milestones for the project per the contract documents. (Example: wall rough in work must take place with the wall construction milestones, etc.)

D. Time is of the essence for this contract.
1. If the contractor fails to meet milestones such as but not limited to structural steel, foundations, building enclosure per specification section 015000, punch list, testing, balancing (if required) including any necessary adjustments or corrections related to such tests, and commissioning.
2. Or fails to obtain L&I Certificate of Occupancy/Utilization on or before dates set forth in this section.
3. Or complete all the work including change orders, by the dates set forth in this section.

The Department shall assess the contractor(s), as Liquidated Damages, not as a penalty for such failure, the sum stipulated within the bid documents per calendar day, until all milestones are met, and all work is completed and accepted by the Department. Liquidated Damages are

also applicable and assessable for noncompliance with the dates listed in the accepted Project Schedule.

E. The milestones listed are intended only to assist the bidders in understanding the potential flow of the work and enumerate some of the critical milestones that will be incorporated into the Project Schedule. The contractors will be responsible for determining the actual order of the required milestones and the logic of the Project Schedule as required to complete the project in the time period indicated in the bid documents.

F. Contractors are advised that the schedule may require multiple crews to work concurrently in all areas of the building(s). When multiple areas are worked concurrently, contractors are required to supervise, staff and equip the job accordingly.

G. It shall be understood that there shall be a number of independent work activities occurring within these buildings by other means of procurement and by other contractors and vendors outside this project. The other work activities shall commence prior to the Final Inspection and/or Closeout Inspection for this project. As such, each prime Contractor shall have an affirmative duty to accommodate this effort while working with and cooperating with all these other entities, individually or collectively, as well as with the Department and Client Agency. The Milestones denoted in this section are established to define the anticipated sequence and identify the areas (as well as time frames) that must be completed to facilitate this effort. Each Prime Contractor shall provide the necessary additional supervision, project management and overall coordination necessary to expedite the work being performed by these others entities. Each Prime Contractor shall consider this condition and include any costs associates with this effort in their bids

1.5 CONSTRUCTION PROGRAM

A. The entire scope of work for the Project (as indicated on the Drawings and Specifications, including all bulletins, addenda and modifications thereto) shall be completed within the time period outlined in this section of the specifications and in accordance with the hereinafter-specified requirements. It shall be the responsibility of each Prime Contractor to inform all suppliers and subcontractors (of any tier) of the construction program procedures. Due to the compressed construction schedule and complexity of construction of this project, work activities shall be performed concurrently; thereby creating accelerated work and inefficient conditions. Each Prime Contractor shall recognize and acknowledge that these working conditions will exist as a contractually inherent feature of this Project. Each Prime Contractor shall account for these conditions in their bid. No additional compensation will be paid for failing to include all requirements as set forth in the construction program.

B. Time is of the essence for this Contract. Each Prime Contractor and all their subcontractors (of any tier) shall employ a sufficient number of qualified employees, supervision/management, equipment and project resources, required to meet the milestones and completion date established for this Project. All activities shall be performed such that required completion dates (including completion of punch list and obtaining L&I Certificate of Occupancy/Utilization) are met as identified in this section. All Contractors are required to employ multiple crews with necessary manpower, equipment, materials, supervision/management etc. to perform the aforementioned work activities. Each Prime Contractor shall perform the Work on multiple shifts as necessary during each 24-hour day period to meet all milestones and complete the various portions of the project by the required completion dates identified in this section. The crew size of the off-shift work must be composed of a sufficient number of workers as required to support all other Prime Contractor’s efforts to do the same. Proper supervision must be provided for all work activities. No work shall be covered or concealed during off-shift work activities in such a manner that it cannot be observed the morning of the next work shift. See paragraph 1.6.F of this specification regarding the Pennsylvania Department of Labor and Industries (L&I) inspections.

C. Pre-installation meetings are required for many items and systems. The pre-installation meetings shall be held the same dates as the regularly scheduled bi-weekly job conferences. Each Prime Contractor shall coordinate with the Department any preinstallation meeting scheduling requirements in order to avoid delays in the installation of any items or systems requiring a pre-installation meeting. Each Prime Contractor requiring a pre-installation meeting to comply with the contract documents, shall request the meeting a minimum of two weeks prior to the scheduled installation of the item or system. Failure to request a pre-installation meeting in the required time period will not relieve the contractors of their responsibility to comply with all contract documents including but not limited to the Project Schedule. No additional compensation or extension of time will be granted by the Department to the contractors for their failure to schedule or attend any of the required pre-installation meetings.

D. Each Prime Contractor shall coordinate with the Department any scheduling requirements in order to avoid disruption of programs and activities, as well as to coordinate the location of the various structures to be constructed (i.e. temporary trailers, temporary construction fences, and temporary access corridors, temporary roadways, temporary doors and windows, temporary enclosures, temporary partitions, etc.) All work performed under this Project shall be done in a manner that will not disrupt normal activities in and around the facility.

E. All Prime Contractors are expected to work outside of normal work hours as necessary, in shifts and on weekends to maintain the Project Schedule. All Prime Contractors are to comply with noise levels restrictions in accordance with all local ordinances. This may require exterior work to be completed during the day shift only.

F. Each Prime Contractor shall coordinate and schedule inspections as required by the provisions of the Building Permit issued by Pennsylvania Department of Labor and Industry (L&I). The L&I Inspectors will only be available during the day shift. L&I Inspectors availability does not constitute a delay to the progress of the project and shall be considered by each Prime Contractor when scheduling and completing the work of this project.

G. It is understood that during the duration of the Project, changes may be made to the Project Schedule without the Department incurring additional costs or granting extensions of time to the Contract.

H. Change Orders shall occur on this project to address unforeseen conditions, errors and/or omissions in the documents and other potential conflicts. It shall be mandatory that each Prime Contractor (along with all its subcontractors of any tier) provides necessary additional work forces to accommodate these changes in a manner to eliminate any delays to milestones or the overall project schedule. The Department will issue no Extension of Time for performance of Change Order work; all time must be recovered in the affected work activities.

I. The Department reserves the right to delay or suspend any work, without compensation due any of the Contractors, if the Department determines that any work would disrupt activities in or around the facility.

J. In the event that:

a. Prime Contractor(s) fails to achieve any interim milestones established for the building program in accordance with the Contract Documents and the Project Schedule or

b. Any schedule update showing the work behind schedule and in jeopardy of meeting the accepted milestone dates,

The Department will notify the Prime Contractor(s) that they are in default of the contract. The defaulting Prime Contractor will be given three (3) calendar days to correct the deficiency. In the event the defaulting Prime Contractor fails to correct the deficiency within three (3)

calendar days or fails to staff the job properly or work the required shifts/overtime/weekends necessary to maintain the schedule and achieve the milestones; in addition to liquidated damages the Department may take necessary actions to ensure the CPM Project Schedule is maintained. All costs and fees associated with such supplementation shall be deducted from the defaulting Prime Contractor's contract value.

K. While time is of the essence, each Prime Contractor (as well as each of their subcontractors of any tier) shall not compromise the safety of any individuals while performing any of their work. Contractors shall take all the necessary precautions to maintain safety during the progress of the work including, but not limited to, fall protection, shoring, barricades, signage, safety tape and rails, temporary ramps, temporary roads, temporary partitions, fencing, etc.

1.6 SEQUENCING OF CONSTRUCTION AND OTHER REQUIREMENTS

A. The following narrative is intended only to assist the bidders in understanding the potential flow of the work and enumerate some of the critical milestones that will be incorporated into the Project Schedule. The contractors will be responsible for determining the actual order of the required milestones and the logic of the Project Schedule as required to complete the project in the time period indicated in the bid documents.

B. Contractors are advised that the schedule may require multiple crews to work concurrently in all areas of the building(s). Multiple areas shall be worked concurrently, and contractors are required to supervise, staff and equip the job accordingly.

C. It shall be understood that there shall be a number of independent work activities occurring within the building by other means of procurement and by other contractors and vendors outside this project. The other work activities shall commence prior to the Final Inspection and/or Closeout Inspection for this project. As such, each prime Contractor shall have an affirmative duty to accommodate this effort while working with and cooperating with all these other entities, individually or collectively, as well as with the Department and Client Agency. The Milestones or items denoted in this section are established to define the anticipated sequence and identify the areas (as well as time frames) that must be completed to facilitate this effort. Each Prime Contractor shall provide the necessary supervision, project management and overall coordination necessary to expedite the work being performed by these other entities. Each Prime Contractor shall consider this condition and include any costs associates with this effort in their bids.

1.7 FURTHER CLARIFICATIONS

A. By submitting a bid, the Contractor acknowledges that the abbreviated list of milestones for construction work (as provided in this section) was provided for informational purposes, and to ensure all Prime Contractors understand the critical mandatory completions/durations necessary to accommodate the requirements and sequence of completion to meet the needs of the Client Agency. It constitutes a proposed sequence of events based on standard construction practices and will not form the basis for any claims for inefficiency, acceleration or delays. The coordinated Project Schedule will be developed in accordance with this section and the Contract Documents by the Prime Contractors and the actual milestone dates for the project will be agreed upon by all Prime Contractors based on the accepted schedule.

B. If there is a conflict between what is stated in this Section and the General Conditions of the Contact, the contract specifications, the contract drawing or the Administrative Procedures, the most stringent requirement within any of these documents shall prevail.

C. The planting of trees, shrubs, turf, grass and other seeds and vegetation specified in the contract documents shall be done in accordance with seasonal planting restrictions defined in the contract documents. This work shall be the only work permitted to take place after contract completion. All other punch lists shall be completed by the dates listed in this section. If the seasonal planting restrictions require the planting of the specified items after contract completion, that requirement will not form the basis for any claims for inefficiency, acceleration, delays or additional costs. No additional compensation will be paid to Prime Contractors for failing to account for these conditions in their respective bids.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

SECTION 014000

QUALITY CONTROL TESTING SERVICES

PART 1 – GENERAL

1.1 STIPULATIONS

A. The specifications sections, "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 GENERAL

A. The Contractor is responsible for verifying and enforcing compliance with all requirements of the Contract Documents. Contractor's responsibility includes, but is not limited to, the following:

1. Supervision of field work to enforce contract compliance of all construction activity.
2. Verification of compliance with plans and specifications of all manufactured materials or equipment. Provide certificates of compliance, or other approved proof of compliance, by the manufacturers and submit to the Professional.
3. Performance of all necessary field measurements and/or inspections to verify compliance with requirements of the plans or specifications requiring adherence to measurable standards of field performance.
4. Engaging an independent testing laboratory to perform tests and inspections as required by this specification section, hereafter referred to as Quality Control Testing and Inspection Services or Quality Control Testing Services.
5. Providing support services for all Quality Control Services, including cutting and patching and repair or replacement as required.

B. Work not included: Quality Assurance Services by the Department are specified in Section 014010. The Department reserves the right to perform tests under the Quality Assurance Testing program and to use those as the basis for approval or rejection at its sole discretion.

1.3 DESCRIPTION OF QUALITY CONTROL TESTING

A. Quality Control Services include inspections, tests and reports by an independent testing laboratory or other approved agency, hereafter referred to as the Quality Control Agency. All Quality Control Services shall be at the Contractor's cost, which shall be included proportionally in all items of payment or contained in any Base Bid or Unit Price on the Proposal. Tests and Inspections are to include those specifically required by this section and within technical sections of the Project Manual.

B. The Quality Control Agent shall submit a Testing and Inspection Plan to the Professional for its approval, and the approval of the Quality Assurance agent for all tests and inspections required by this section and within technical sections of the Project Manual.

C. Quality Control Services by a Quality Control Agency or Agencies is intended to assist in the determination of probable compliance of the work with requirements specified or indicated and do not relieve the Contractor of the responsibility for compliance with Contract Document requirements.

D. Specific testing or inspections of a structural nature required to be performed by independent Quality Control Agencies for individual construction activities are specified in this Section only. If testing or inspection requirements appear in this section and a technical section, the most stringent requirements shall prevail. If Quality Control Testing or Inspection is specified in a technical section and not in this section, it shall be required as if specified in this section. Non-structural tests and inspections are in the technical specifications.

E. Inspections, tests and related actions specified are not intended to limit the Contractor's quality control procedures that facilitate compliance with Contract Documents requirements.

F. Quality Control Services required by the local municipality or other governing authorities are the responsibility of the Contractor, regardless of whether or not specified hereinafter or in the applicable specification section.

G. Each prime Contractor will pay for all costs in connection with its Quality Control Services. Whenever the word "Contractor" is used it shall be interpreted to mean Prime Contractor or Contractors as applicable. All Contractors performing work for which testing or inspection is required by this section are required to perform said tests/inspections appropriate for the quantity of work performed as indicated by this specification section and as required by all Contract Documents.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 RESPONSIBILITIES AND DUTIES OF CONTRACTOR

A. The Contractor shall engage Quality Control Agencies to provide all Quality Control Services required to comply with the Contract Documents. These services shall be at no cost to the Department.

B. The Contractor is responsible for retesting where results of required inspections, tests or similar services prove unsatisfactory and indicate non-compliance with Contract Document requirements. Likewise, the Contractor is responsible for retesting when the Department's Quality Assurance Test results prove unsatisfactory. If Quality Assurance Tests were in error, the Contractor shall be reimbursed for his retesting costs.

C. Cost of retesting construction revised or replaced by the Contractor is the Contractor's responsibility.

D. Provide the Quality Control Agency with preliminary representative samples of materials to be tested in quantities requested. If the source, quality or characteristics of an approved material changes or indicates lack of compliance with Contract requirements, submit additional samples of materials to the Quality Control Agency.

E. When requested by the Professional, the Department, or the Quality Control Agency, the Contractor shall immediately provide reports, cutting lists, material bills, shipping bills, time and place of shipment of materials to shop and field and any relevant data on previous testing and investigations of materials.

F. Provide casual labor and facilities:

1. To provide access to the work inspected or tested by any authorized party.
2. To obtain and handle samples at the site.
3. To facilitate inspections and tests by the Quality Control Agency or Quality Assurance Agency.
4. For security and protection of samples and test equipment at the project site.

G. To facilitate the timely sequence of inspection and testing, the Contractor shall give advanced notification to the Quality Control Agency and the Department that work has progressed to a point where inspection and testing may proceed.

H. Contractor shall pay for additional cost of Quality Control Agency services which, in the opinion of the Professional and the Department, are required because of the following:

1. Failure of materials or workmanship to meet Contract requirements.
2. Materials or practices not complying with the technical specifications which could possibly result in defective and unacceptable work.
3. Changes in source, quality or characteristics of materials.
4. Site cured concrete cylinders requested by the Contractor.

I. The Quality Control Agency shall submit a certified written report of each inspection, test or similar service to the Design Professional, the Quality Assurance Agent, the Bureau of Construction Regional Director, Project Manager and Assistant Project Manager, and the Contractor, with additional copies directly to any governing authority when that authority so directs. All reports shall be uploader to e-Builder within 24 hours of when the inspection occurs, test is conducted, test results obtained or similar service was conducted.

J. Report Data: Written reports of each inspection, test or similar service shall include, but not be limited to:

1. Date of issue.
2. Project title and number.
3. Name, address and telephone number of testing agency.
4. Dates and location of samples and tests or inspections.
5. Names of individuals making the inspection or test.
6. Designation of the Work and test method.
7. Identification of product and specification section.
8. Complete inspection or test data.
9. Test results and an interpretation of test results.
10. Ambient conditions at the time of sample taking and testing.
11. Comments or professional opinion as to whether inspected or tested work complies with Contract Document requirements.
12. Name and signature of Quality Control Agency inspector.

K. The QC Agent shall cooperate in using standard forms/procedures developed by the Department that assist in accomplishing the tasks required.

L. Engage independent testing laboratories, whose employees assigned to the Project and tests performed comply with ASTM E 329, Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction. The testing laboratory must be accredited and audited by a qualified national authority. The Contractor is to submit the name and credentials of the proposed QC Agent to the Design Professional and the Department for acceptance.

M. Upon completion of inspection, testing, sample taking and similar activities, repair the damaged work and restore substrates and finishes to eliminate deficiencies, including deficiencies in the visual qualities of exposed finishes. Comply with the Contract Document requirements for "Cutting and Patching". Protect work exposed by or for Quality Control Testing activities, and protect repaired work.

N. All required testing/inspection, including that stated in the body of the technical specification sections (be it referenced in the technical specifications as “Quality Control”, “Quality Assurance”, or any other referenced testing and/or inspection) shall be performed by the Contractor, unless it explicitly states it shall be performed by the Department. If stated to be performed by the Department, the Contractor shall still be required to perform all necessary testing/inspection in advance of the Department to assure the work meets all the requirement of the contract documents.

O. Contractor shall coordinate closely with the Department, the Professional and the Professional's QA Agencies and Consultants so that any required or desired QA testing can be performed concurrently or immediately after the Contractor's QC testing.

3.2 RESPONSIBILITIES AND DUTIES OF QUALITY CONTROL AGENCIES

A. Quality Control Agencies engaged to perform inspections, sampling and testing of materials and construction shall cooperate with the Professional, the Quality Assurance Agent, the Department, the Department of Labor and Industry, and the Contractor in performance of its duties, and shall provide qualified personnel to perform required inspections and tests. If it is determined by the Department that the personnel provided are not qualified or are not working in the best interests of the Project for the tests performed, the Contractor, through their Quality Control Agent, shall immediately replace or supplement the subject personnel.

B. Quality Control Agencies shall notify the Department, the Quality Assurance Agent, the Professional, and the Contractor immediately of irregularities or deficiencies observed in the Work during performance of its services.

3.3 QUALITY CONTROL SERVICES TO BE PERFORMED

A. Testing and inspections by the Quality Control Agency or Agencies shall include, but are not limited to, the following list.

LIST OF TESTS AND INSPECTIONS

NOTE: LINE ITEMS WITH ~~STRIKE THROUGH~~ ARE NOT REQUIRED.

DESCRIPTION OF TEST OR INSPECTION	REFERENCED STANDARD	QUANTITY OR FREQUENCY
BITUMINOUS PAVEMENT		
Bulk Specific Gravity…of Compacted Bituminous Mixtures…	ASTM D1188 or D 2726	1 test
Density of Bituminous Concrete in Place by Nuclear Method	ASTM D2950	6 tests/1000sy paving
Thickness or Height of Compacted Bituminous Paving Mixture Specimens	ASTM D3549	3 tests/1000sy paving
EARTHWORK[1]		
Laboratory Compaction Characteristics of Soil Using Modified Effort	ASTM D1557	One for each type and variation of cohesive soil to be compacted
Laboratory Compaction Characteristics of Soil Using Standard Effort	ASTM D698	One for each type and variation of cohesive soil to be compacted
Density of Soil and Soil-Aggregate In Place by Nuclear Methods	ASTM D6938	As often as required to ensure contract compliance
Inspect and comment on suitability of subgrades. Test footing excavations and paving subgrades regardless if it is native material or fill and record resultant foundation bearing capacity or compaction results as applicable.	N/A	As often as required to ensure the minimum required bearing capacity is present. Bearing Capacity tests must be witnessed and/or reviewed by the Department, Professional, Professional's Geotechnical Engineer or QA Agent.
Verify use of proper materials, densities and lift thicknesses during placement and compaction of compacted fill.	ASTM D6938	Continuous
CONCRETE		
Practice for Sampling Freshly Mixed Concrete. (5 cylinders/test) Perform air tests when sampling concrete. Perform slump tests and record temperature for all concrete deliveries. Compressive Strength of Cylindrical Concrete Specimens	ASTM C143, C1064, C231 or C173 or C138, C172, C31 C39	For each mix, 1 test for each day of concreting or for each 50cy, whichever is greater. For non-structural concrete, 1 test for each 100cy is adequate.
Inspection of bolts to be installed in concrete prior to and during placement of concrete, where allowable loads have been increased or where strength design is used	AWS D1.4; ACI 318: 3.5.2	
Inspection of concrete placement for proper application techniques	ACI 318: 5.9, 5.10	Continuous

DESCRIPTION OF TEST OR INSPECTION	REFERENCED STANDARD	QUANTITY OR FREQUENCY
CONCRETE CONTINUED		
Verification of slump flow and VSI as delivered to the site for self-consolidating grout	ACI 530	Continuous
~~**CAST STONE**~~		
~~Absorption of Architectural Cast Stone~~	~~ASTM C1195~~	~~1 Test~~
MASONRY		
Constructing and Testing Masonry Prisms Used to Determine Compliance with Specified Compressive Strength of Masonry (3 prisms/test)	ASTM C1314	1 Test
Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry, Annex A7 Compressive Strength (3 cylinders/test) (Contractor makes cylinders.)	ASTM C 780	1 Test/5000 units of masonry for each mortar type.
Sampling and Testing Grout (3 cubes/test) (Contractor makes cubes)	ASTM C1019	1 Test/25 CY grout.
Observation of any grout specimens and/or prisms	ACI 30.1/ASCE 6/TMS 602 Art 1.4	Continuous
~~**STRUCTURAL STEEL**~~		
~~High Strength Bolting~~	~~AISC ASD or LRFD M2.5~~	~~Comply with current requirements of RCSC~~
~~Liquid Penetrant Examination~~	~~ASTM E165~~	~~Test 15% of critical field welds using _____ method **[to be specified by structural engineer herein]**~~
~~Guide for Magnetic Particle Examination~~	~~*ASTM E709*~~	
~~Practice for Ultrasonic Contact Examination of Weldments~~	~~ASTM E164~~	
~~Guide for Radiographic Examination~~	~~ASTM E94~~	

Footnotes:

1. Refer to Earthwork Section for additional details.

END OF SECTION

SECTION 014010

QUALITY ASSURANCE TESTING AND INSPECTION SERVICES

PART 1 – GENERAL

1.1 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 GENERAL

A. All testing and inspecting specifically called for and/or described in this section of the specifications are referred to as Quality Assurance Services and are the responsibility of the Quality Assurance Agency. Except as hereinafter specified, Quality Assurance Services will be performed without expense to the Contractor. The Quality Assurance Agency is an independent testing and inspecting agency engaged by the Department through the Professional. Testing required because of changes in materials or proportions at the request of the Contractor shall be at the Contractor's expense. The Professional may engage more than one Quality Assurance Agency to perform services. Whenever the word "Contractor" is used it shall be interpreted to mean Prime Contractor or Contractors as applicable.

B. Work Not Included: Quality Control Testing to be performed by the Contractor is specified in Section 014000.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 RESPONSIBILITIES AND DUTIES OF THE CONTRACTOR

A. The use of Quality Assurance Services shall in no way relieve the Contractor of its responsibility to furnish materials and construction in full compliance with the plans and specifications or to perform Quality Control Testing where specified.

B. To facilitate Quality Assurance Inspection or Testing, the Contractor shall:

1. Secure and deliver to the project site, without cost, representative samples of materials it proposes to use and which are required to be tested under Paragraph 3.4, ‘Tests and Inspections’.
2. Furnish such casual labor as is necessary to obtain and handle samples at the project or at other sources of material.
3. Provide means of safe access to work areas, provide conditions that allow testing and inspection to take place, provide materials for testing as requested, patch test sites when completed and furnish incidental labor and assistance necessary for inspectors of the Quality Assurance Agency to perform their tests and inspections.

3.2 AUTHORITY AND LIMITATIONS OF QUALITY ASSURANCE AGENCY

A. Personnel representing the Quality Assurance Agency will not act as foremen nor perform other duties for the Contractor.

B. Work will be checked as it progresses, but failure to detect any defective work or materials shall not in any way prevent later rejection when such defect is discovered, nor shall it obligate the Department or the Professional for final acceptance.

C. The Quality Assurance Agency is not authorized to revoke, alter, relax, enlarge, or release any requirements of the specifications, nor to approve or accept any portion of the work.

D. The Quality Assurance Agency shall report all test and inspection results to the Professional, the Department and the Contractor immediately after they are performed. Selection and frequency of tests shall be at the discretion of the Professional and the Department. All reports shall be uploader to e-Builder within 24 hours of when the inspection occurs, test is conducted, test results obtained or similar service was conducted.

E. Written reports of each inspection, test or similar service shall include but not be limited to:

1. Date of issue.
2. Project title and number.
3. Name, address and telephone number of testing agency.
4. Dates and location of samples and tests or inspections.
5. Names of individuals making the inspection or test.
6. Designation of the Work and test method.
7. Identification of product and specification section.
8. Complete inspection or test data.
9. Test results and an interpretation of test results.
10. Ambient conditions at the time of sample taking and testing.
11. Comments or professional opinion as to whether inspected or tested work complies with Contract Document requirements.
12. Name and signature of Quality Control Agency inspector.

F. When it appears that any material furnished or work performed by the Contractor fails to fulfill contract requirements, the Quality Assurance Agency shall report such deficiency to the Professional, the Department and the Contractor.

3.3 CONTRACTOR'S FAILURE TO MEET CONTRACT REQUIREMENTS

A. The Department and the Professional reserve the right to reject any items which do not meet the requirements of the plans and specifications and will require the contractor to replace these items and bear all expenses in connection with such replacements.

B. The Contractor shall pay all costs incurred in providing additional testing and/or analysis (including engineering fees) required because of deficient test results or construction not in compliance with requirements of the Contract Documents.

3.4 TESTS AND INSPECTIONS

A. Tests and inspections listed below may, at the discretion of the Professional and the Department, be performed by an independent Quality Assurance Agency engaged by the Department through the Professional, without expense to the Contractor. The Department reserves the right to change this list at any time.

SECTION 1
NOTE: LINE ITEMS WITH ~~STRIKE THROUGH~~ ARE NOT REQUIRED.

REQ'D BY[1]	DESCRIPTION OF TEST OR INSPECTION	REFERENCED STANDARD	IBC REFER-ENCE[2]
	BITUMINOUS PAVING		
DGS	Field inspection of construction procedures		
DGS	Bulk Specific Gravity…of Compacted Bituminous Mixtures…	ASTM D1188 or D 2726	
DGS	Density of Bituminous Concrete in Place by Nuclear Method	ASTM D 2950	
DGS	Thickness or Height of Compacted Bituminous Paving Mixture Specimens	ASTM D 3549	
	CONCRETE		
IBC	1. Inspection of reinforcing steel, including prestressing tendons, and placement	ACI 318: 3.5, 7.1-7.7	1913.4
~~IBC~~	~~2. Inspection of reinforcing steel welding, in accordance with Table 1704.3, Item 5b~~	~~AWS D1.4; ACI 318: 3.5.2~~	
IBC	3. Inspection of bolts to be installed in concrete prior to and during placement of concrete, where allowable loads have been increased or where strength design is used	ACI 318: 8.1.3, 21.2.8	1911.5 1912.1
~~IBC~~	~~4. Inspection of anchors installed in hardened concrete~~	~~ACI 318: 3.8.6, 8.1.3, 21.2.8~~	~~1912.1~~
IBC	5. Verifying use of required design mix	ACI 318: Ch. 4, 5.2-5.4	1904.22, 1913.2, 1913.3
IBC	6. At the time fresh concrete is sampled to fabricate specimens for strength tests, perform slump and air content tests, determine the temperature of the concrete	ASTM C172, C31; ACI 318: 5.6, 5.8	
~~IBC~~	~~7. Inspection of concrete and shotcrete placement for proper application techniques~~	~~ACI 318: 5.9, 5.10~~	~~1913.6, 1913.7, 1913.8~~
IBC	8. Inspection for maintenance of specified curing temperature and techniques	ACI 318; 5.11-5.13	1913.9
~~IBC~~	~~9. Inspection of prestressed concrete:~~ ~~a. Application of prestressing forces~~ ~~b. Grouting of bonded prestressing tendons in the seismic-force-resisting system~~	~~ACI 318: 18.20~~ ~~ACI 318: 8.18.4~~	
~~IBC~~	~~10. Erection of precast concrete members~~	~~ACI 318: Ch.16~~	
~~IBC~~	~~11. Verification of in-situ concrete strength, prior to stressing of tendons in post-tensioned concrete and prior to removal of shores and forms from beams and structural slabs.~~	~~ACI 318: 6.2~~	
~~IBC~~	~~12. Inspect formwork for shape, location and dimensions of the concrete member being formed.~~	~~ACI 318: 6.1.1~~	

REQ'D BY[1]	DESCRIPTION OF TEST OR INSPECTION	REFERENCED STANDARD	IBC REFER-ENCE[2]
DGS	Review Contractors' design mixes, Certificates of Compliance and material test reports		
DGS	Compressive Strength of Cylindrical Concrete Specimens[2]	ASTM C39	
	~~**CAST STONE**~~		
~~DGS~~	~~Absorption of Architectural Cast Stone~~	~~ASTM C1195~~	
	MASONRY		
DGS	Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry, Annex A7 Compressive Strength[6]	ASTM C780	
DGS	Method of Sampling and Testing Grout[6]	ASTM C1019	
	Level 1 Special Inspection		
IBC	1. Compliance with required inspection provisions of the construction documents and the approved submittals shall be verified.	Art. 1.5[5]	
IBC	*2.* Verification of f'_m and f'_{AAC} prior to construction except where specifically exempted by this code.	Art. 1.4B[5]	
IBC	3. Verification of slump flow and VSI as delivered to the site for self-consolidating grout.	Art. 1.5B.1.b.3[5]	
IBC	4. As masonry construction begins, the following shall be verified to ensure compliance: a. Proportions of site-prepared mortar b. Construction of mortar joint ~~c. Location of reinforcement connectors, prestressing tendons and anchorages~~ ~~d. Prestressing technique~~ ~~e. Grade and size of prestressing tendons and anchorages~~	 Art 2.6A[5] Art 3.3B[5] ~~Art 3.4, 3.6A[5]~~ ~~Art 3.6B[5]~~ ~~Art 2.4B, 2.4H[5]~~	
IBC	5. The inspection program shall verify: a. Size and location of structural elements b. Type, size and location of anchors, including other details of anchorage of masonry to structural members, frames or other construction. c. Specified size, grade and type of reinforcement, anchor bolts, prestressing tendons and anchorages. d. Welding of reinforcing bars e. Preparation, construction and protection of masonry during cold weather (temperature below 40°F) or hot weather (temperature above 90°F) ~~f. Application and measurement of prestressing force~~	 Art 3.3F[5] Sec 1.2.2(e)[4], 1.16.1[4] Sec 1.15[4], Art 2.4, 3.4[5] Sec 2.1.9.7.2, 3.3.3.4(b)[4] Art 1.8C, 1.8D[5] ~~Art 3.6B[5]~~	Sec 2104.3, 2104.4

REQ'D BY[1]	DESCRIPTION OF TEST OR INSPECTION	REFERENCED STANDARD	IBC REFER-ENCE[2]
IBC	6. Prior to grouting, the following shall be verified to ensure compliance: a. Grout space is clean ~~b. Placement of reinforcement and connectors and prestressing tendons and anchorages~~ c. ~~Proportions of site-prepared grout and prestressing grout for bonded tendons~~ d. Construction of mortar joints	Art 3.2D[5] Sec 1.13[4], ~~Art 3.4[5]~~ ~~Art 2.6B[5]~~ Art 3.3B[5]	
IBC	7. Grout placement shall be verified to ensure compliance with code and construction document provisions ~~a. Grouting of prestressing bonded tendons~~	Art 3.5[5] ~~Art 3.6C[5]~~	
IBC	8. Preparation of any required grout specimens, mortar specimens and/or prisms shall be observed	Art 1.4[5]	Sec 2105.2.2, 2105.3
	~~**Level 2 Special Inspection**~~		
~~IBC~~	~~1. Compliance with required inspection provisions of the construction documents and the approved submittals shall be verified~~	~~Art 1.5[5]~~	
~~IBC~~	~~2. Verification of f'_m and f'_{AAC} prior to construction and for every 5000 square feet during construction~~	~~Art. 1.4B[5]~~	
~~IBC~~	~~3. Verification of proportions of materials in premixed or preblended mortar and grout as delivered to the site~~	~~Art. 1.5B[5]~~	
~~IBC~~	~~4. Verification of slump flow and VSI as delivered to the site for self-consolidating grout~~	~~Art. 1.5B.1.b.3[5]~~	
~~IBC~~	~~5. The following shall be verified to ensure compliance:~~ ~~a. Proportions of site-prepared mortar, grout and prestressing grout for bonded tendons~~ ~~b. Placement of masonry units and construction of mortar joints~~ ~~c. Placement of reinforcement, connectors and prestressing tendons and anchorages~~ ~~d. Grout space prior to grouting~~ ~~e. Placement of grout~~ ~~f. Placement of Prestressing grout~~ ~~g. Size and location of structural elements.~~ ~~h. Type, size and location of anchors, including other details of anchorage of masonry to structural members, frames or other construction.~~ ~~i. Specified size, grade and type of reinforcement, anchor bolts, prestressing tendons and anchorages.~~ ~~j. Welding of reinforcing bars.~~ ~~k. Preparation, construction and protection of masonry during cold weather (temperature below 40°F) or hot weather (temperature above 90°F).~~ ~~l. Application and measurement of prestressing force.~~	~~Art 2.6A[5]~~ ~~Art 3.3B[5]~~ ~~Sec 1.15[4],~~ ~~Art 3.4, 3.6A[5]~~ ~~Art 3.2D[5]~~ ~~Art 3.5[5]~~ ~~Art 3.6C[5]~~ ~~Art 3.3F[5]~~ ~~Sec.1.2.2(e),~~ ~~1.16.1[4]~~ ~~Sec. 1.15[4]~~ ~~Art. 2.4, 3.4[5]~~ ~~Sec. 2.1.9.7.2, 3.3.3.4 (b)[4]~~ ~~Art. 1.8C, 1.8[5]~~ ~~Art. 3.6B[5]~~	~~2104.3, 2104.4~~
~~IBC~~	~~6. Preparation of any required grout specimens and/or prisms shall be observed~~	~~Art 1.4[5]~~	~~2105.2.2~~ ~~2105.3~~
	~~**STEEL CONSTRUCTION**~~		

REQ'D BY[1]	DESCRIPTION OF TEST OR INSPECTION	REFERENCED STANDARD	IBC REFER-ENCE[2]
IBC	1. Material verification of high-strength bolts, nuts, and washers: a. Identification markings to conform to ASTM standards spec in the approved CDs. b. Manufacturer's Certificate of Compliance required	AISC 360, Section A3.3 and applicable ASTM material standards	
IBC	2. Inspection of high-strength bolting: a. Snug-tight joints b. Pretensioned and slip-critical joints using turn-of-nut with matchmarking, twist-off bolt or direct tension indicator methods of installation. c. Pretensioned and slip-critical joints using turn-of-nut without matchmarking or calibrated wrench methods of installation (N/A; DGS requires twist-off bolt or direct tension indicator)	AISC 360, Section M2.5	1704.3.3
IBC	3. Material verification of structural steel and cold-formed steel deck: a. For structural steel, identification markings to conform to AISC 360 b. For other steel, identification markings to conform to ASTM standards specified in the approved CDs c. Manufacturer certified test reports	AISC 360, Section M5.5 Applicable ASTM material standards	
IBC	4. Material verification of weld filler materials: a. Identification markings to conform to AWS specification in the approved CDs b. Manufacturer's Certificate of Compliance required	AISC 360, Sect A3.5 and applicable AWS A5 documents	
IBC	5. Inspection of welding: a. Structural steel 1) Complete and partial penetration groove welds 2) Multi-Pass fillet welds 3) Single-pass fillet welds > 5/16" 4) Plug and slot welds 5) Single-pass fillet welds < 5/16" 6) Floor and deck welds b. Reinforcing steel: 1) Verification of weldability of reinforcing steel other than ASTM A 706 2) Reinforcing steel resisting flexural and axial forces in intermediate and special moment frames, and boundary elements of special reinforced concrete shear walls, and shear reinforcement 3) Shear reinforcement 4) Other reinforcing steel	AWS D1.1 AWS D1.3 AWS D1.4 ACI 318: Section 3.5.2	1704.3.1 1704.3.1
IBC	6. Inspection of steel frame joint details for compliance with approved CDs: a. Details such as bracing and stiffening b. Member locations c. Application of joint details at each connection		1704.3.2
DGS	Liquid Penetrant Examination	ASTM E165	
DGS	Guide for Magnetic Particle Examination	ASTM E709	

REQ'D BY[1]	DESCRIPTION OF TEST OR INSPECTION	REFERENCED STANDARD	IBC REFER-ENCE[2]
DGS	~~Practice for Ultrasonic Contact Examination of Weldments~~	~~ASTM E164~~	
DGS	~~Guide for Radiographic Examination~~	~~ASTM E94~~	
	~~**COLD-FORMED STEEL TRUSSES**~~		
~~IBC~~	~~Cold-formed steel trusses spanning 60 feet or greater~~		~~1704.3.4~~
	WOOD		
IBC	Inspection of wood truss connections to framing. Inspection of bottom plate bolt tie down connections.		1704.2, 1704.6
	~~**SPRAYED FIRE-RESISTANT MATERIALS**~~		
~~IBC~~	~~Professional to determine requirements.~~		~~1704.12~~
	~~**MASTIC AND INTUMESCENT FIRE-RESISTANT COATINGS**~~		
~~IBC~~	~~Professional to determine requirements.~~	~~AWCI 12-B.~~	~~1704.13~~
	~~**EXTERIOR INSULATION AND FINISH SYSTEMS**~~		
~~IBC~~	~~Professional to determine requirements.~~		~~1704.14~~
	~~**SEISMIC RESISTANCE**~~		
~~IBC~~	~~Professional to determine requirements.~~		~~1705, 1707, 1708~~
	~~**WIND REQUIREMENTS**~~		
~~IBC~~	~~Professional to determine requirements.~~		~~1706~~
	GENERAL OVERVIEW OF QC TESTING		
DGS	Review of Contractor QC Testing and Reports		

SECTION 2

REQD BY[1]	DESCRIPTION OF TEST OR INSPECTION	REFERENCED STANDARD	IBC REFER-ENCE[2]
	SOILS		
IBC	1. Verify materials below shallow foundations are adequate to achieve the design bearing capacity		1704.7

IBC	2. Verify excavations are extended to proper depth and have reached proper material		1704.7
IBC	3a. Perform testing of compacted fill materials	ASTM D6938	1704.7
	3b. Perform classification of proposed compacted fill		1704.7
	~~3c. Perform Modified Proctor testing of proposed compacted fill~~	~~ASTM D1557~~	~~1704.7~~
	3d. Perform Standard Proctor testing of proposed compacted fill	ASTM D698	1704.7
IBC	4. Verify use of proper materials, densities and lift thicknesses during placement and compaction of compacted fill		1704.7
IBC	5. Prior to placement of compacted fill, observe subgrade and verify that site has been prepared properly		1704.7
	~~**DRIVEN DEEP FOUNDATIONS**~~		
~~IBC~~	~~1. Verify element materials, sizes and lengths comply with the requirements.~~		~~1704.8~~
~~IBC~~	~~2. Determine capacities of test elements and conduct additional load tests, as required.~~		~~1704.8~~
~~IBC~~	~~3. Observe driving operations and maintain complete and accurate records for each element.~~		~~1704.8~~
~~IBC~~	~~4. Verify placement locations and plumbness, confirm type and size of hammer, record number of blows per foot of penetration, determine required penetrations to achieve design capacity, record tip and butt elevations and document any damage to foundation element.~~		~~1704.8~~
~~IBC~~	~~5. For steel elements, perform additional inspections in accordance with Section 1704.3.~~		~~1704.8~~
~~IBC~~	~~6. For concrete elements and concrete-filled elements, perform additional inspections in accordance with Section 1704.4.~~		~~1704.8~~
~~IBC~~	~~7. For specialty elements, perform additional inspections as determined by the registered design professional in responsible charge.~~		~~1704.8~~
	~~**CAST-IN-PLACE DEEP FOUNDATION ELEMENTS**~~		
~~IBC~~	~~1. Observe drilling operations and maintain complete and accurate records for each element.~~		~~1704.9~~
~~IBC~~	~~2. Verify placement locations and plumbness, confirm element diameters, bell diameters (if applicable), lengths, embedment into bedrock (if applicable) and adequate end-bearing strata capacity.[8] Record concrete or grout volumes.~~		~~1704.9~~
~~IBC~~	~~3. For concrete elements, perform additional inspections in accordance with Section 1704.4.~~		~~1704.9~~

	~~**HELICAL PILE FOUNDATIONS**~~		
~~IBC~~	~~Professional to determine requirements.~~		~~1704.10~~
	~~**VERTICAL MASONRY FOUNDATION ELEMENTS**~~		
~~IBC~~	~~Professional to determine requirements.~~		~~1704.11~~
	ENGINEERING SERVICES		
DGS	Review of Contractor QC Test Reports.		
DGS	Review of Contractor QC Soil Bearing Test Reports.		
~~DGS~~	~~On-site Engineering Consultation[7]~~		
~~DGS~~	~~Office Engineering Consultation[7]~~		

Footnotes:

1. "DGS" are tests required by DGS and "IBC" are test required by Chapter 17 of the 2009 International Building Code.
2. IBC 2009.
3. Not used.
4. Refers to reference ACI 530/ASCE 5/TMS 402.
5. Refers to reference ACI 530.1/ASCE 6/TMS 602.
6. Concrete, mortar or grout molds are to be made by QA Agent under Special Inspection hours.
7. Principal(s) shall be Registered Professional Engineer(s). The Engineer making decisions and recommendations shall be a Registered Pennsylvania Professional Engineer.

END OF SECTION

SECTION 015000

TEMPORARY UTILITIES

PART 1 – GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions of the Construction Contract”, “Special Conditions”, and “Division 1 - General Requirements” form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 TEMPORARY SERVICES DURING CONSTRUCTION

A. The designated Contractor shall install, operate, protect and maintain the temporary services, as hereinafter specified, during the construction of the entire Project.

B. Temporary connections to new and/or existing permanent service lines shall be made at the appropriate locations as determined by the designated Contractor, and coordinated with the Department, in conjunction with the Client Agency (as applicable). When the temporary service lines are no longer required, they shall be removed by the Contractor. Any part or parts of the permanent service lines, grounds and building, disturbed and damaged by the installation and/or removal of the temporary service lines, shall be restored to their original condition by the Contractor responsible for the temporary installation.

C. If the Contractor fails to carry out its responsibility in supplying temporary services as set forth in this Contract, it is responsible for such failure, and the Department may take such action as it deems proper for the protection and conduct of the work, and shall deduct the cost involved from the amount due the Contractor. Only those temporary utilities required for construction need to be extended to the work area(s).

D. Temporary utilities for Prime Contractors' office trailers shall be arranged and paid for by each responsible Prime Contractor. The Lead Contractor shall arrange, provide, install, and pay for all temporary utilities required for the DGS Construction Coordinator's office.

1.3 TEMPORARY WATER SUPPLY

A. The Plumbing Contractor shall install, operate, protect and maintain an adequate water supply during the period of construction, either by means of the permanent water supply line, or by the installation of a temporary water supply. The temporary water supply shall be in place within fifteen (15) days of any Prime Contractor’s written request for such services.

B. The Plumbing Contractor will be required to bring the temporary water supply to a point approximately ten (10) feet from the work area(s) and to provide a meter and RPZ back-flow preventer.

C. The Lead Contractor shall pay all charges for water consumption, except for testing, as specified in Section 010400**.**

D. There is an existing well onsite that may be utilized at Plumbing Contractor’s option. Contractor would need to provide temporary power to the well and provide new well pump prior to use. Well test information is available at Contractor’s request.

1.4 TEMPORARY HEAT

A. Temporary heat is applicable only to the Personnel Staging Building. The temporary heat requirements on this Project are divided into two (2) categories: (1) temporary heat required

prior to the enclosure of the building, buildings, or portions thereof; and (2) temporary heat required subsequent to the enclosure of the building, buildings or portions thereof.

B. A building or portion thereof shall be considered to be enclosed when (a) the roof is on and tight; (b) the exterior walls have been completed; and (c) when openings, doors and windows are closed with permanent closures, or with substantial temporary closures which will affect the retention of heat within the building or portion thereof.

C. Prior to enclosure of building, buildings or portions thereof, and when official local weather predictions indicate below freezing temperatures or temperatures that may damage the work, each Contractor shall provide, maintain, operate and pay all costs, including fuel, for a sufficient number of approved portable heaters, so that the progress of its work is not impeded, and proper protection of its work from freezing is maintained. Self-contained oil/gas/propane-fired portable heaters, if used, must be vented to the outside of the enclosed structure. Unvented fuel-fired portable heaters may be used only when the building is not enclosed.

D. After the building, buildings or portions thereof are enclosed, and temporary heat is required for proper construction, the HVAC Contractor, at its own cost and expense, shall provide equipment and heating personnel for the temporary heat. The HVAC Contractor may, with the Department's and Client Agency's approval, utilize the permanent system or portions thereof, or may install temporary steam or hot water radiation or convectors or a combination of both. The HVAC Contractor shall operate portable steam or hot water generating equipment for supply to permanent or temporary building heating facilities.

E. Temporary heating system, as hereinafter noted, shall be of sufficient capacity to heat the interior of the building to 60^0F when outside temperature is 0^0F. The interior temperature must be 60^0F or above at all times. This service shall be continued until the entire Project is completed, except as hereinafter noted.

F. Where electricians or plumbers are required to install, operate supervise or maintain equipment used in the provisions of temporary heat, the payment of the services of such material and personnel shall be the responsibility of the Electrical and the Plumbing Contractors respectively. It will be the responsibility of the Electrical and Plumbing Contractors to coordinate with the HVAC Contractor for temporary heat.

G. The Lead Contractor shall pay for all fuel and electricity for the temporary heat in conjunction with the operation of heating equipment for enclosed buildings, or enclosed portions thereof, unless provided by the Client Agency as noted above.

H. The Lead Contractor shall remove normal soot, smudges, and other deposits from walls, ceilings and exposed surfaces which are the result of the use of any temporary heating equipment after enclosure, including the use of the permanent heating system for temporary heating purposes. Finish work shall not start until all such surfaces are properly cleaned. Soot, etc. caused by equipment malfunction shall be removed by the responsible Contractor. Each Prime Contractor shall correct/replace any of their respective work that is identified by the Department or Professional as not meeting the project specifications as a result of the failure of any Prime Contractor to maintain or provide appropriate temporary heat, cooling, dehumidification, or ventilation in accordance with the contract requirements or the manufactures requirements. Each Prime Contractor will follow the requirements of the General Conditions regarding any disputes due to another Prime Contractor's failure to provide or maintain proper temporary heating, cooling, dehumidification, or ventilation of the conditioned space. Each Prime Contractor shall correct/replace any of their respective work that does not meet Contract requirements due to use of temporary heat.

I. All permanent heating equipment used to supply temporary heat shall be completely cleaned and reconditioned by the HVAC Contractor, in the presence of the Department personnel, prior to Final Acceptance. Cleaning of permanent HVAC ducts utilized for temporary heat shall be required. The HVAC Contractor should filter the return air at grilles, and wherever necessary to prevent dust accumulation. All permanent heating equipment, such as radiator trap seats and

diaphragms, valve sets and discs, strainer internals or any other equipment found to be damaged due to being used for temporary heat shall be replaced. All replacements must be inspected by the Professional and accepted by the Department personnel. The HVAC Contractor shall pay for all replacement parts and labor.

J. The cost of temporary heat shall be made a part of the lump sum bid submitted by each Contractor, as applicable. The cost of temporary heat after enclosure shall be shown on the Contract Schedule of Values, to include the number of calendar days, cost per twenty-four (24) hour day and extended price. Any adjustment to the number of days of temporary heat, used or not used, may be based on this unit price. Each Contractor shall include ***60*** calendar days of temporary heat after building enclosure, in its bid.

K. Temporary Ventilation and Temperature Control: The Lead Contractor shall provide electronic daily temperature/humidity readings equipment and log the conditions throughout the building to assure the proper and adequate temperature/humidity levels are recorded and maintained. The Lead Contractor shall provide the appropriate temporary ventilation, dehumidification, humidification or cooling equipment to assure the interior humidity/temperature levels are provided to meet all building finish requirements in accordance with the manufacture requirements.

1.5 CONSTRUCTION LIGHT AND POWER

A. The Electrical Contractor shall install, operate, protect and maintain the temporary service for construction light and power. The Contractor shall extend the temporary wiring throughout the project work areas, properly insulated and installed in accordance with Article 300 of the National Electrical Code. All wiring shall be installed by a licensed electrician.

B. The Electrical Contractor shall furnish this service within fifteen (15) days of any Prime Contractor's written request for such services. The service shall be sized to satisfy project requirements, but shall not be less than 200 amp, single-phase, 3-wire 120/240 volts, with fused safety switch protection required. Additional capacity in the form of other independent services and panels shall be provided as needed at required location throughout the site to meet the requirements of this section.

C. The Electrical Contractor shall extend electrical wiring into the building to provide adequate light and power, for the proper execution of the work. The Electrical Contractor shall also provide three-phase, 208 volt power service, if required. As construction progresses, it shall extend the temporary services to all areas where required, with a minimum of 100W incandescent equivalent light and duplex power outlets at 20 feet on center minimum, and at least in every room or space. The maximum size motor to be used at any power service shall be limited to 5 hp. Construction light and power provided shall fully comply with all provisions for this service of the National Electric Code and OSHA.

E. Where a service of a type other than that as herein mentioned is required, each Contractor requiring same shall provide such service and necessary equipment at its own expense.

E. The Electrical Contractor, prior to the installation of the permanent service, shall provide portable generators or shall extend a temporary service line to the site, and shall sign for the meter and pay all electrical connection costs.

F. The Electrical Contractor shall provide all transformers necessary to provide temporary power.

G. The Electrical Contractor shall provide all meters and/or submeters required and necessary to meter usage.

H. The Lead Contractor shall pay all electric consumption and associated costs for its use and that of all Prime Contractors, until Closeout Inspection occurs, and all items of work are certified to be complete.

1.6 WELDING

A. Any Contractor using electrical power for welding on the site shall use self-contained engine generating units.

B. Each Contractor shall provide necessary exhaust/ventilation/filtration to prevent accumulation of welding fumes and smoke generated by welding their operations.

C. Each Contractor shall have all precautions and protection in place while welding to assure no sparks cause fire or smoke damage to all surrounding areas; during and after all welding activities.

1.7 FIRE EXTINGUISHERS

A. Each Contractor shall provide UL listed, NFPA approved fire extinguishers, ten (10) lb. minimum, at the construction site during operations, suitable for all types of fires in accordance with OSHA.

1.8 INTERRUPTION OF SERVICES

A. Each Prime Contractor shall have all needed equipment and material to complete planned work at the site, prior to shutting down any system.

B. No additional compensation or time will be given to the Contractor, if work must be performed on State or National Holidays or on weekends or on overtime. See paragraph on 'Working Hours' under Section 010400.

1.9 SNOW/ICE REMOVAL

A. The Lead Contractor shall be responsible to provide snow removal and anti-skid material into to site and at the project site and indicated laydown areas (including construction trailer), unless directed otherwise.

B. All related work shall be performed to provide proper and safe access throughout the site subsequent to each related work day. Any delay and potential related costs generated by failure to meet this requirement shall be the responsibility of the Lead Contractor.

1.10 DEWATERING

A. Each Prime Contractor shall provide adequate attention, equipment and manpower to the project to assure the work area is dewatered as required to eliminate ponding, excessive water, depressions, etc. as affected by and for their work activities. Such action shall occur no later than 24 hours after a rain or water producing event. This effort shall be sustained for the time period necessary to bring the affected area back into conformance.

1.11 HOISTING FACILITIES

A. Each Prime Contractor must provide hoisting facilities for its own work. All hoisting facilities must comply with the safety regulations of the Department of Labor and Industry.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. UNDERSTRENGTH CONCRETE

A. If compressive strength of in situ concrete is accepted, either without additional testing or on the basis of testing other than original cylinder compressive strength tests, the Contractor shall compensate The Department for the Contractor’s failure to meet specified strength requirements by paying The Department one hundred ($100) dollars per cubic yard for each one hundred pounds per square inch (100 psi) below the specified strength. The original laboratory cured 28 day cylinder compressive strength test results only shall be used to determine the difference between specified and furnished strengths.

1.3. SUMMARY

A. Section Includes:

1. Cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes for slabs on grade and concrete toppings.

1.4. DEFINITIONS

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

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.5. PREINSTALLATION MEETINGS

A. 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, construction joints, semirigid joint fillers, joint fillers, forms and form removal limitations, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, methods for achieving specified floor and slab flatness and levelness, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.6. ACTION SUBMITTALS

A. Product Data: For each type of product.

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 Joint Layout: Drawings indicate proposed slab construction joint locations.

1. Alterations to locations of proposed construction joints are subject to approval of the Architect.

1.7. INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, manufacturer, and testing agency.

B. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Curing compounds.
6. Floor and slab treatments.
7. Bonding agents.
8. Vapor retarders
9. Adhesives.
10. Joint fillers.
11. Repair materials.

C. Material Test Reports: For the following, from a qualified testing agency:

1. Aggregates: Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
2. Aggregates: Include certification of ASTM C33 Class 3S aggregates.

D. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

E. Field quality-control reports.

F. Minutes of preinstallation conference.

1.8. QUALITY CONTROL

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as

1. 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."
2. Manufacturer shall have at least five years of documented experience in developing and producing concrete mix designs for use with dry shake-on hardeners.

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.

1.9. PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on concrete mixtures.

1.10. DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.

1.11. FIELD CONDITIONS

A. 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.

B. 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.

PART 2 - PRODUCTS

2.1. CONCRETE, GENERAL

A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, “Specifications for Structural Concrete,” Sections 1 through 5.
2. ACI 117, “Specifications for Tolerances for Concrete Construction and Materials.”
3. ACI 360R, “Guide to Design of Slabs-on-Ground.”

2.2. FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that 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. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed, for hidden surfaces.
    b. Medium-density overlay, Class1 or better; mill-release agent treated and edge sealed, for surfaces exposed to view.

B. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

C. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

D. Form Ties: Factory-fabricated, removable or snap-off 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 ties that, when removed, leave holes no larger than 1/2 inch in diameter in concrete surface.

2.3. STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

B. Plain-Steel Wire: ASTM A 1064, as drawn.

C. Deformed-Steel Wire: ASTM A 1064.

D. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064, plain, fabricated from as-drawn steel wire into flat sheets.

2.4. REINFORCEMENT ACCESSORIES

A. Stainless Steel Plate Dowels: Grade 304L SS plate dowels and plastic sleeve system.

B. 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.

2.5. CONCRETE MATERIALS

A. 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.

B. Cementitious Materials:

1. Portland Cement: ASTM C 150, Type I.

C. Normal-Weight Aggregates: ASTM C 33/C 33M, Class 3S coarse aggregate or better, graded, except provide Class 4S coarse aggregate for exposed slabs, ramps, stairs, and walls. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: 1-1/2 inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Air-Entraining Admixture: ASTM C 260.

E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do 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 (superplasticizer): ASTM C 494, Type F.
    a. Application: Provide in exposed slabs, ramps, stairs, and walls.
5. 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.

2.6. CURING MATERIALS

A. Moisture-Retaining Cover: ASTM C 171, rayon, polyester, cellulose, or polypropylene film:
    1. Basis-of-Design Products: Subject to compliance with requirements, provide SIKA Corporation USA: UltraCure DOT, or comparable product by one of the following:
        a. PNA Construction Technologies: HydraCure M5.
        b. Reef Industries, Inc.: Transguard 4000.
        c. Or equal as approved by the Professional.

B. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
    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. BASF Construction Chemicals - Building Systems; Confilm.
        b. Euclid Chemical Company (The), an RPM company; Eucobar.
        c. L&M Construction Chemicals, Inc.; E-CON.
        d. Meadows, W. R., Inc.; EVAPRE.
        e. Sika Corporation; SikaFilm.
        f. Or equal as approved by the Professional.

C. Water: Potable.
    1. Moisture-retaining covers shall be maintained and kept wet as recommended by the manufacturer.

2.7. LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.
    1. Basis-of-Design Products: Subject to compliance with requirements, provide L&M Construction Chemicals, Inc; Seal Hard or comparable product by one of the following:
        a. Dayton Superior: Sure Hard Densifier J17.
        b. Euclid Chemical Company (The); an RPM company: Eucosil
    2. Or equal as approved by the Professional.

B. Apply to all exposed concrete surfaces

2.8. RELATED MATERIALS

A. Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

B. Joint Filler/Sealant: Self-leveling, polyurethane elastomeric sealant:

1. Products: Subject to compliance with requirements, provide one of the following:
    a. SIKA Corporation USA: SIKAFlex-2c SL.
    b. The Euclid Chemical Company: Eucolastic 1SL
    c. BASF: MasterSeal SL 2.
    d. Or equal as approved by the Professional.

C. Bonding Agent: ASTM C 1059, Type II, nonredispersible, 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 IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.9. 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.

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.

2.10. CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, and for CLSM, 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.

2. Trial mixtures or field test data, or both, shall have all specified mixture constituents, including HRWR, silica fume, and crystalline waterproofing admixture.

B. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.

C. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing or high-range water-reducing admixture in concrete, for placement and workability, and as follows:
    a. Use high-range water-reducing admixture (superplasticizer) at exposed slabs, ramps, stairs, and walls.
    b. Recommended high-range water-reducing admixture dosage shall take into consideration effects of silica fume in the concrete mix.
2. Add a retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

2.11. CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Interior Slabs on Grade, Foundations and Walls: Normal-weight concrete.

1. Minimum Compressive Strength: 4,000 psi at 28 days.
2. Minimum cementitious materials: 610 lb./cubic yard for 1-1/2-inch nominal maximum aggregate size. Increased minimum will be required if smaller size aggregate is used.
3. Slump Limit: 4 inches, plus or minus 1 inch.
4. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent

B. Exterior Slabs, Door Stoops and other Concrete Elements exposed to Weather on Grade, and all elements on the **Salt Storage Structure:** Normal-weight concrete.

1. Minimum Compressive Strength: 5,000 psi at 28 days.
2. Minimum cementitious materials: 720 lb./cubic yard for 1-1/2-inch nominal maximum aggregate size. Increased minimum will be required if smaller size aggregate is used.
3. Maximum W/C Ratio: 0.40.
4. Slump Limit: 4 inches or 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture, plus or minus 1 inch.
    a. Provide high-range water-reducing admixture (superplasticizer) in exposed slabs, ramps, stairs, and walls.
5. Air Content: 7.5 percent, plus or minus 1.0 percent at point of delivery for1-1/2 inch nominal maximum aggregate size.
   Provide ASTM C33 Class 4S aggregate in exposed slabs, ramps, stairs and walls.

C. Exterior Slabs, Door Stoops and other Concrete Elements exposed to Weather on Grade that are **not the Salt Storage Structure**. Normal-weight concrete.

1. Minimum Compressive Strength: 4,500 psi at 28 days.
2. Minimum cementitious materials: 660 lb./cubic yard for 1-1/2-inch nominal maximum aggregate size. Increased minimum will be required if smaller size aggregate is used.

3. Maximum W/C Ratio: 0.40.
4. Slump Limit: 4 inches or 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture, plus or minus 1 inch.
    a. Provide high-range water-reducing admixture (superplasticizer) in exposed slabs, ramps, stairs, and walls.
5. Air Content: 6 percent, plus or minus 1.0 percent at point of delivery for1-1/2 inch nominal maximum aggregate size.
6. Provide ASTM C33 Class 4S aggregate in exposed slabs, ramps, stairs and walls.

2.12. FABRICATING REINFORCEMENT

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

2.13. CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, and furnish batch ticket information.
    1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1. FORMWORK INSTALLATION

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. Provide formwork that conforms to ACI 347.3R Formed Concrete Surface Category CSC3 for exposed walls and slab edges.

E. Construct forms tight enough to prevent loss of concrete mortar.

F. Construct 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.

G. 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.

H. 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.

I. Chamfer exterior corners and edges of permanently exposed concrete.

J. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

K. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

L. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

M. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2. EMBEDDED ITEM INSTALLATION

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 303.
2. Install embedded slab-edge steel angles flush with vertical and horizontal surfaces.

3.3. VAPOR-RETARDER INSTALLATION

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

1. Refer to Section 07 10 00 “Underslab Vapor Barrier and Dampproofing” for additional installation requirements.

3.4. STEEL REINFORCEMENT INSTALLATION

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of earth, ice, and other foreign materials that 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 AWX D1.4, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

3.5. 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 the Professional:

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. Locate horizontal joints in walls at underside of floors, and at the top of footings or floor slabs.
3. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
4. Use self-expanding butyl strip waterstops at all construction joints.

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 does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
2. Fill joints with joint filler/sealant.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces.

1. Terminate full-width and depth joint-filler strips 1/2 inch below finished concrete surface.
2. Fill top of joint with joint filler/sealant.
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.

3.6. CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Professional.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

1. 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 is 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 not to 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. 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.

3.7. FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Do not float finish exterior air entrained concrete

C. Broom Finish: Apply broom finish to exterior concrete slabs, ramps and stairs.

1. 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 Professional before application.

D. Trowel Finish: After applying float finish, and dry-shake floor hardener if applicable, 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 hard trowel finish to surfaces exposed to view.
2. Finish surfaces to the following tolerances, according to ASTM E 1155, 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) 30; and of levelness, F(L) 20; for slabs-ongrade.

3.8. MISCELLANEOUS CONCRETE ITEM INSTALLATION

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.

3.9. 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. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including slabs, ramps, and stairs.

E. Cure concrete according to ACI 308.1, by the following method:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
    a. 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. Follow manufacturer’s recommendations for application, wetting, and moisture maintenance.

F. Protect slab, ramp and stair surfaces for the period after curing and prior to application of liquid floor treatment. Use protective methods and materials to prevent exposure of concrete surface to direct foot traffic, wheeled traffic, material storage, etc.

3.10. LIQUID FLOOR TREATMENT APPLICATION

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

1. Apply to slabs, ramps, and stairs.
2. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
3. Do not apply to concrete that is less than 7 days' old.
4. Follow manufacturer’s written application procedures. At a minimum 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 at manufacturer’s recommended timeframe.

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.

3.11. JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

C. Install joint sealant full depth in saw-cut joints and isolation joints.

3.12. CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Professional. Remove and replace concrete that cannot be repaired and patched to Professional'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, form-tie voids, and other 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 specified bonding agent. Fill and compact with vertical surface patching material before bonding agent has dried.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar matches 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 Professional.

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. 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.

3. 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.
4. 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.
5. 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.
6. 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 Professional’s approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Professional's approval.

3.13. FIELD QUALITY ASSURANCE

A. Special Inspections: DGS will engage a special inspector and qualified testing and inspecting agency (Quality Assurance Agency) to perform field tests and inspections and prepare test reports, in accordance with Section 014010 “Quality Assurance and Inspection Services.”

B. Testing Agency: Engage a qualified testing and inspecting agency (Quality Control Testing Services) to perform tests and inspections and to submit reports, in accordance with Section 014000 “Quality Control Testing.”

C. Inspections:

1. Steel reinforcement placement.
2. Headed bolts and studs
3. Verification of use of required design mixture.
4. Concrete placement, including conveying and depositing.
5. Curing procedures and maintenance of curing temperature

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 for each 50 cu. yd. or fraction thereof, whichever is greater.

a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143; 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 or 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31.
    a. a. Cast and laboratory cure three sets of two standard 6 by 12 inch cylinder specimens, or three sets of three 4 x 8 inch cylinder specimens, for each composite sample.
6. Compressive-Strength Tests: ASTM C 39; test one set of laboratory-cured specimens at 7 days and one set of specimens at 28 days. Retain one set for testing at 56 days if necessary.
    a. A compressive-strength test shall be the average compressive strength from a set of two 6 by 12 inch or three 4 by 8 inch specimens obtained from same composite sample and tested at age indicated.
7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
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 Professional, 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 Professional 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 Professional. 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 Professional.
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 within 24 hours of finishing.

3.14. PROTECTION OF LIQUID FLOOR TREATMENTS

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

END OF SECTION 03 30 00

SECTION 04 22 00

CONCRETE UNIT MASONRY

GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

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. Embedded flashing.
7. Miscellaneous masonry accessories.

B. Related Sections:

1. Section 03 30 00 "Cast-in-Place Concrete"
2. Section 09 91 23 “Interior Painting”
3. Section 07 10 00 “Air-Moisture Barrier, Vapor Barrier and Dampproofing”
4. Section 07 60 00 "Flashings and Sheet Metal "
5. Section 07 65 00 “Flexible Flashing Stainless Steel”

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 by testing masonry prisms according to ASTM C 1314.

1.5. PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Contractor 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. Mortar Test (Property Specification): For each mix required, according to ASTM C 109/C 109M for compressive strength.
2. Mortar Test (Property Specification): For each mix required, according to ASTM C 780 for compressive strength.
3. Grout Test (Compressive Strength): For each mix required, according to ASTM C 1019.

4. 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. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. 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.
3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Verification: For each type and color of the following:

1. Accessories embedded in masonry.

1.7. INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Material Certificates: For each type and size of the following:

1. Masonry units.
    a. Include data on material properties.
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.

C. 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.

D. 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.

1.8. QUALITY CONTROL

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. Preinstallation Conference: Conduct a conference at the Project site to review coordination of the work and material mock-ups as applicable prior to the start of concrete masonry installation.

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 square-edged units for outside corners unless otherwise indicated.
3. Provide field-ground bullnose corners at interior partition outside wall corner locations.

B. CMUs: ASTM C 90.

1. Density Classification: Normal weight.
2. Size: Manufactured to dimensions 3/8 inch less than nominal dimensions.
3. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.

2.3. 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.
   d. Water: Potable.

2.4. 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: Hot-dip galvanized, carbon steel.
2. Exterior Walls: Hot-dip galvanized, carbon steel.
3. Wire Size for Side Rods: 0.148-inch (3.77-mm) diameter.
4. Wire Size for Cross Rods: 0.148-inch (3.77-mm) diameter.
5. Wire Size for Veneer Ties: 0.148-inch (3.77-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.

2.5. 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.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- (6.35-mm-) diameter, hot-dip galvanized steel wire.
2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch (25 mm) of masonry face, made from 0.187-inch- (4.76-mm-) diameter, hot-dip galvanized steel wire.

C. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.105-inch- (2.66-mm-) thick, steel sheet, galvanized after fabrication.
2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch (25 mm) of masonry face, made from 0.187-inch- (4.76-mm-) diameter, hot-dip galvanized steel stainless-steel wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.

D. 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, hot-dip galvanized after fabrication.

E. Rigid Anchors: Fabricate from steel bars 1-1/2 inches (38 mm) wide by 1/4 inch (6.35 mm) thick by 24 inches (610 mm) long, with ends turned up 2 inches (51 mm) or with cross pins unless otherwise indicated.

1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M.

2.6. MISCELLANEOUS ANCHORS

A. Anchor Bolts: Headed 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.

B. Postinstalled Anchors: chemical anchors.

1. Load Capacity: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
2. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 unless otherwise indicated.
3. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.7. EMBEDDED FLASHING MATERIALS

A. Application: Unless otherwise indicated, use the following:

1. Where flashing is indicated to receive counterflashing, use metal flashing.
2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.

3. Where flashing is fully concealed, use metal flashing.

B. Solder and Sealants for Sheet Metal Flashings: As specified in Section 076200 "Sheet Metal Flashing and Trim."

1. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
2. Solder for Copper: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead.
3. Elastomeric Sealant: ASTM C 920, chemically curing urethane, polysulfide or silicone sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

C. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.8. 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 mortar unless otherwise indicated.
3. For exterior masonry, use portland cement-lime mortar.
4. For reinforced masonry, use portland cement-lime 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, Property 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 S.
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 or to match existing adjacent construction; 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. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.

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. 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. Wet joint surfaces thoroughly before applying mortar.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.6. MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).

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 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 36 inches (915 mm) o.c. horizontally.

3.8. CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry:

1. Install preformed control-joint gaskets designed to fit standard sash block.
2. 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.

C.

3.9. FLASHING

A. General: Install embedded flashing in masonry at lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At lintels, extend flashing a minimum of 6 inches (150 mm) into masonry at each end. At heads and sills, extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.
3. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches (38 mm) or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
4. Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
5. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall and adhere flexible flashing to top of metal flashing termination.

C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

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 AND ASSURANCE

A. Quality Control Testing Agency: The Contractor shall engage in a qualified testing and inspecting agency (Quality Control Testing Services) to perform tests and inspections and to submit reports, in accordance with specifications.

B. Quality Assurance Special Inspections: DGS will engage a special inspector and qualified testing and inspecting agency (Quality Assurance Agency) to perform field tests and inspections and prepare test reports, in accordance with specifications.

3.12. PARGING

A. Parge exterior faces of masonry walls, where indicated, in 2 uniform coats to a total thickness of 3/4 inch (19 mm). Dampen wall before applying first coat and scarify first coat to ensure full bond to subsequent coat.

B. Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of 1/8 inch per foot (3 mm per 300 mm). Form a wash at top of parging and a cove at bottom.

C. Damp-cure parging for at least 24 hours and protect parging until cured.

3.13. 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 non-masonry 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.

3.14. MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Crush masonry waste to less than 4 inches (100 mm) in each dimension.
2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste.
3. Do not dispose of masonry waste as fill within 18 inches (450 mm) of finished grade.

C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Client Agency’s property.

END OF SECTION 04 22 00

SECTION 05 43 00
SLOTTED CHANNEL FRAMING

PART I – GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full

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1.2 SUMMARY

A. Framing shall be a strut type metal framing system
B. Strut System shall be used:
   1. To support mechanical and electrical equipment and devices.
C. Strut System and components must be supplied from a single approved Manufacturer.

1.3 QUALITY CONTROL

A. Manufacturer's qualifications:
   1. The manufacturer shall have at least 10 years' experience in manufacturing Strut Systems.
   2. The manufacturer must certify in writing all components supplied have been produced in accordance with an established quality assurance program.
B. Work shall meet the requirements of the following standards:
   1. Federal, State and Local codes
   2. American Iron and Steel Institute (AISI) Specification for the Design of Cold- Formed Steel Structural Members 2001 Edition
   3. American Society for Testing And Materials (ASTM)
   4. Metal Framing Manufacturer's Association (MFMA)

1.4 SUBMITTALS

A. Delegated Design: Design drawings and structural calculations shall be prepared by a structural engineer licensed to practice in the Commonwealth of Pennsylvania. Calculations may include, but are not limited to:
   1. Description of design criteria
   2. Stress and deflection analysis
   3. Selection of framing members, fittings, and accessories
B. Assembly drawings necessary to install the Strut System in compliance with the Contract Drawings
C. Pertinent manufacturers published data

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 WARRANTY

A. Manufacturer shall warrant for 1 year from the shipment date that products will be free from defects in material or manufacture. In the event of any such defect in violation of the warranty, Manufacturer shall have the option to repair or replace any such defective product.
B. Installer shall warrant for 1 year from the date of completion of work that the work will be free of defects in installation. In the event of any such defect in violation of the warranty, Installer shall have the option to repair or replace any such defective product.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Manufacturer : Atkore Unistrut
B. Other acceptable manufacturers include: Unistrut Service Company, Flex-Strut or other manufacturer as approved by Architect.

2.2 MATERIALS

A. All channel members shall be fabricated conforming to the following ASTM specifications:
   1. Pre-Galvanized Carbon Steel: A 653 Grade 33

B. All fittings shall be fabricated conforming to one of the following ASTM specifications:

   1. Stainless Steel:
      a. ASTM 240 (Type 304 or Type 316)
      b. ASTM 276 (Type 304 or Type 316)

2.3 FINISHES

A. HOT-DIPPED GALVANIZED per ASTM A123 or A153
   1. Zinc coated after all manufacturing operations are complete
   2. Zinc coating thickness shall be G65 (2.6 mils = 1.50 oz./ sq. ft. surface area)

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. Installation shall be accomplished by a fully trained manufacturer authorized installer.
B. Set Strut System components into final position true to line, level and plumb, in accordance with approved drawings.
C. Anchor material firmly in place, and tighten all connections to their recommended torques.

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, it shall be the responsibility of the installer to 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 05 43 00

SECTION 05 50 00

METAL FABRICATIONS

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. SUMMARY

A. Section Includes:

1. Steel framing and supports for mechanical and electrical equipment.
2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
3. Metal bollards.
4. Loose bearing and leveling plates for applications where they are not specified in other Sections.

B. Products furnished, but not installed, under this Section include the following:

1. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

C. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.

1.3. COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. 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.

1.4. ACTION SUBMITTALS

A. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:

1. Steel framing and supports for mechanical and electrical equipment.
2. Steel framing and supports for applications where framing and supports are not specified in other Sections.

3. Metal bollards.

1.5. INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.6. QUALITY CONTROL

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

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7. FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1. PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2. METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.

D. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.

2.3. FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless-steel fasteners for fastening stainless steel.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

C. "Steel Bolts and Nuts" Paragraph below specifies weathering steel bolts and nuts.

D. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325, Type 3 (ASTM A 325M, Type 3); with hex nuts, ASTM A 563, Grade C3 (ASTM A 563M, Class 8S3); and, where indicated, flat washers.

E. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

F. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

G. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

2.4. MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting" or Section 099123 Interior Painting."

B. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

C. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.5. FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

2.6. MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Furnish inserts for units installed after concrete is placed.

C. Galvanize miscellaneous framing and supports where indicated.

2.7. MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Prime exterior miscellaneous steel trim with zinc-rich primer.

2.8. METAL BOLLARDS

A. Fabricate metal bollards from Schedule 40 steel pipe.

B. Prime bollards with zinc-rich primer.

2.9. LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Prime plates with zinc-rich primer.

2.10. STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.11. FINISHES, GENERAL

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.12. STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with primers specified in Section 099113 "Exterior Painting" unless zinc-rich primer is indicated.

D. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:

1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
4. Other Items: SSPC-SP 3, "Power Tool Cleaning."

E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1. INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:

3.2. INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for operable partitions securely to, and rigidly brace from, building structure.

C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.

D. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installing Bearing and Leveling Plates" Article.

1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.3. INSTALLING METAL BOLLARDS

A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.

1. Do not fill removable bollards with concrete.

B. Anchor bollards in concrete as indicated. Fill annular space around bollard solidly with nonshrink grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch (3 mm) toward bollard.

C. Fill bollards solidly with concrete, mounding top surface to shed water.

1. Do not fill removable bollards with concrete.

3.4. INSTALLING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.5. ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting."

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 05 50 00

SECTION 06 10 00

ROUGH CARPENTRY

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. SUMMARY

A. This Section includes the following:

1. Wood blocking, cants, and nailers.
2. Wood furring and grounds.

1.3. DEFINITIONS

A. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) or greater but less than 5 inches nominal (114 mm actual) in least dimension.

B. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. NeLMA: Northeastern Lumber Manufacturers' Association.
2. NLGA: National Lumber Grades Authority.
3. RIS: Redwood Inspection Service.
4. SPIB: The Southern Pine Inspection Bureau.
5. WCLIB: West Coast Lumber Inspection Bureau.
6. WWPA: Western Wood Products Association.

1.4. SUBMITTALS

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

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments specified to be High-Temperature (HT) type, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. Fastener Patterns: Full-size templates for fasteners in exposed framing.

C. 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.

D. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.
3. Engineered wood products.
4. Power-driven fasteners.
5. Powder-actuated fasteners.
6. Expansion anchors.

1.5. QUALITY CONTROL

A. Source Limitations for Wood Products: Obtain each type of wood product through one source from a single manufacturer.

1. Dimension lumber framing.
2. Miscellaneous lumber.

1.6. DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1. WOOD PRODUCTS, GENERAL

A. 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. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.

2.2. WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA C2, except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWPA C31 with inorganic boron (SBX).

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.

2.3. FIRE-RETARDANT-TREATED MATERIALS

A. General: Comply with performance requirements in AWPA C20 (lumber) and AWPA C27 (plywood).

1. Use Exterior type for exterior locations and where indicated.
2. Use Interior Type A, unless otherwise indicated.

B. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.

C. Application: Treat items indicated on Drawings, and the following:

1. Concealed blocking.
2. Plywood backing panels.

2.4. 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. Cants.
4. Grounds.

B. For items of dimension lumber size, provide Construction or No. 2 grade lumber with 15 percent maximum moisture content of any species.

D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.5. FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.

1. Where 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. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).

F. 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.

G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

2.6. METAL FRAMING ANCHORS

A. 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. Cleveland Steel Specialty Co.
2. Simpson Strong-Tie Co., Inc
3. USP Structural Connectors.

2.7. ALLOWABLE DESIGN LOADS:

A. Provide products with allowable design loads, as published by manufacturer, that meet or exceed those indicated

1. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.

2.8. MISCELLANEOUS MATERIALS

A. Adhesives for Gluing Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

1. Use adhesives that have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chloropyrifos as its active ingredient.

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, grounds, and similar supports to comply with requirements for attaching other construction.

B. Framing Standard: Comply with AF&PA's "Details for Conventional Wood Frame Construction," unless otherwise indicated.

C. Do not splice structural members between supports, unless otherwise indicated.

D. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406 mm) o.c.

E. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

F. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

G. 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.

H. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; do not countersink nail heads, unless otherwise indicated.

3.2. WOOD GROUND, SLEEPER, BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

C. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

D. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches (38 mm) wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3. 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 06 10 00

SECTION 06 16 00

SHEATHING

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. SUMMARY

A. This Section includes the following:

1. Roof sheathing
2. Sheathing joint-and-penetration treatment
3. Flexible flashing at openings in sheathing. (Provide around window and louver openings and joints between dissimilar materials)
4. Plywood Backing Panels and Sheathing

B. Related Sections include the following:

1. Division 06 16 00 Section Rough Carpentry

1.3. SUBMITTALS

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

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
3. For fire-retardant treatments specified to be High-Temperature (HT) type, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5516.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:

1. Preservative-treated plywood.
2. Fire-retardant-treated plywood.

1.4. QUALITY CONTROL

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".

1.5. DELIVERY, STORAGE, AND HANDLING

A. Stack plywood and other panels flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1. WOOD PANEL PRODUCTS, GENERAL

A. Plywood: DOC PS 1

B. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

C. Factory mark panels to indicate compliance with applicable standard.

2.2. PRESERVATIVE-TREATED PLYWOOD

A. Preservative Treatment by Pressure Process: AWPA C9.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

2.3. PLYWOOD BACKING PANELS

A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.

2.4. WALL SHEATHING (PERSONNEL STAGING BUILDING)

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

B. Basis-of-Design Product: Subject to compliance with requirements, provide Huber Engineered Woods LLC; AdvanTech Sheathing

1. Or other manufacturer as approved by Architect.

C. Span Rating and Performance Category: Not less than 32/16, 1/2" Performance Category

D. Provide fastening as directed on contract drawings.

2.5. ROOF SHEATHING (PERSONNEL STAGING BUILDING)

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

B. Basis-of-Design Product: Subject to compliance with requirements, provide Huber Engineered Woods LLC; AdvanTech Sheathing

1. Or other manufacturer as approved by Architect.

C. Span Rating and Performance Category: Not less than 48/24, 3/4" Performance Category

D. Edge Profile: Tongue and groove.

E. Provide fastening as directed on contract drawings.

2.6. 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 of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening Sheathing to Wood Roof Trusses:

1. For wall and roof sheathing panels, provide screws with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.
2. Fasteners shall be of type as recommended by sheathing manufacturer for intended use and in compliance with applicable codes.

2.7. MISCELLANEOUS MATERIALS

A. Adhesives for Field Gluing Panels: Formulation complying with APA AFG-01 ASTM D 3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

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).

B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
    a. Carlisle Coatings & Waterproofing; CCW-705-TWF Thru-Wall Flashing.

b. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Vycor Plus Self-Adhered Flashing
c. Or approved equal.

C. Primer for Flexible Flashing: Product recommended by manufacturer of flexible flashing for substrate.

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.

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. "Fastening Schedule," in ICC's "International Building Code."

D. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

E. Coordinate wall 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.

F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2. SHEATHING JOINT-AND-PENETRATION TREATMENT

A. Seal sheathing joints according to sheathing manufacturer's written instructions.

1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient quantity 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 board 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. 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.

3.3. FLEXIBLE FLASHING INSTALLATION

A. Apply flexible flashing where indicated to comply with manufacturers written instructions.

1. Prime substrates as recommended by flashing manufacturer.
2. Lap seams and junctures with other materials at least 4 inches (100 mm), except that at flashing flanges of other construction, laps need not exceed flange width.
3. Lap flashing over weather-resistant building paper at bottom and sides of openings.
4. Lap weather-resistant building paper over flashing at heads of openings.
5. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates.

END OF SECTION 06 16 00

SECTION 06 17 53

SHOP-FABRICATED WOOD TRUSSES

PART 1 - GENERAL

1.1.1 STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Wood roof trusses.

1.3 DEFINITIONS

A. Metal-Plate-Connected Wood Trusses: Planar structural units consisting of metal-plate-connected members fabricated from dimension lumber and cut and assembled before delivery to Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For wood-preservative-treated lumber, metal-plate connectors, metal truss accessories, and fasteners.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification from treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification from treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to truss fabricator.

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, sizes, and materials for permanent bracing required to prevent buckling of individual truss members due to design loads.
4. Indicate type, size, material, finish, design values, orientation, and location of metal connector plates.

5. 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 licensed to practice in the Commonwealth of Pennsylvania responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer and fabricator.

B. Material Certificates: For dimension lumber specified to comply with minimum specific gravity. Indicate species and grade selected for each use and specific gravity.

C. Product Certificates: For metal-plate-connected wood trusses, signed by officer of truss-fabricating firm.

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

1. Wood-preservative-treated lumber.
2. Metal-plate connectors.
3. Metal truss accessories.

1.6 QUALITY CONTROL

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, complies with quality-control procedures in TPI 1, and involves third-party inspection by an independent testing and inspecting agency acceptable to Architect and authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

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

1. Store trusses flat, off of ground, and adequately supported to prevent lateral bending.
2. Protect trusses from weather by covering with waterproof sheeting, securely anchored.
3. Provide for air circulation around stacks and under coverings.

B. Inspect trusses showing discoloration, corrosion, or other evidence of deterioration. Discard and replace trusses that are damaged or defective.

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: Metal-plate-connected wood trusses shall be capable of withstanding design loads within limits and under conditions indicated. Comply with requirements in TPI 1 unless more stringent requirements are specified below.

1. Design Loads: As indicated.
2. Maximum Deflection under Design Loads:

    a. Roof Trusses: Vertical deflection of 1/360 of span.

C. Comply with applicable requirements and recommendations of TPI 1, TPI DSB, and SBCA BCSI.

D. Wood Structural Design Standard: Comply with applicable requirements in AF&PA's "National Design Specifications for Wood Construction" and its "Supplement."

2.2 DIMENSION LUMBER

A. Lumber: DOC PS 20 and applicable rules of any rules-writing agency certified by the American Lumber Standard Committee (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. Provide dressed lumber, S4S.
3. Provide dry lumber with 19 percent maximum moisture content at time of dressing.

B. Permanent Bracing: Provide wood bracing that complies with requirements for miscellaneous lumber in Section 061053 "Miscellaneous Rough Carpentry."

2.3 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.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat all trusses unless otherwise indicated.

2.4 METAL CONNECTOR PLATES

A. Manufacturers:

1. Alpine Engineered Products, Inc.
2. Eagle Metal Products.
3. MiTek Industries, Inc.
4. Or Approved Equal.

B. Fabricate connector plates to comply with TPI 1.

C. Hot-Dip Heavy-Galvanized-Steel Sheet: ASTM A653/A653M; 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 coating designation; and not less than 0.036 inch thick.

1. Use for wood-preservative-treated lumber and where indicated.

2.5 FASTENERS

A. 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 A153.

B. Nails, Brads, and Staples: ASTM F1667.

2.6 METAL FRAMING ANCHORS AND ACCESSORIES

A. Manufacturers:

1. Cleveland Steel Specialty Co.
2. Phoenix Metal Products, Inc.
3. Simpson Strong-Tie co., Inc.
4. Or Approved Equal.

B. Allowable design loads, as published by manufacturer, shall comply with 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. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.

C. Hot-Dip Heavy-Galvanized-Steel Sheet: ASTM A653/A653M; 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 coating designation; and not less than 0.036 inch thick.

1. Use for wood-preservative-treated lumber and where indicated.

D. Truss Tie-Downs: Bent strap tie for fastening roof trusses to wall studs below, 1-1/2 inches wide by 0.050 inch thick. Tie fastens to one side of truss, top plates, and side of stud below.

2.7 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20, with dry film containing a minimum of 92 percent zinc dust by weight.

2.8 FABRICATION

A. Cut truss members to accurate lengths, angles, and sizes to produce close-fitting joints.

B. Fabricate metal connector plates to sizes, configurations, thicknesses, and anchorage details required to withstand design loads for types of joint designs indicated.

C. 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.

D. 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. Install trusses plumb, square, and true to line and securely fasten to supporting construction.

F. Space trusses 24 inches o.c.; adjust and align trusses in location before permanently fastening.

G. 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.

H. 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 061053 "Miscellaneous Rough Carpentry."

I. Install wood trusses within installation tolerances in TPI 1.

J. Do not alter trusses in field. Do not cut, drill, notch, or remove truss members.

K. Replace wood trusses that are damaged or do not comply with requirements.

1. Damaged trusses may be repaired according to truss repair details signed and sealed by the qualified professional engineer responsible for truss design, when approved by Architect.

3.2 REPAIRS AND 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. Repair damaged galvanized coatings on exposed surfaces according to ASTM A780/A780M and manufacturer's written instructions.

3.3 FIELD QUALITY ASSURANCE

A. Special Inspections: Owner will engage a qualified special inspector to perform special inspections to verify that temporary installation restraint/bracing and the permanent individual truss member restraint/bracing are installed in accordance with the approved truss submittal package.

END OF SECTION 06 17 53

SECTION 06 18 00
GLUED-LAMINATED-CONSTRUCTION

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section includes framing using structural glued-laminated timber.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for dimension lumber items associated with structural glued-laminated timber.

1.3 DEFINITIONS

A. Structural Glued-Laminated (Glulam) Timber: An engineered, stress-rated timber product assembled from selected and prepared wood laminations bonded together with adhesives and with the grain of the laminations approximately parallel longitudinally.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data on lumber, adhesives, fabrication, and protection.
2. For preservative-treated wood products. Include chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.
3. For connectors. Include installation instructions.

B. Shop Drawings:

1. Show layout of structural glued-laminated timber system and full dimensions of each member.
2. Indicate species and laminating combination.
3. Include large-scale details of connections.

C. Delegated-Design Submittal: For structural glued-laminated timber and timber connectors.
1. Fabrication drawings and connections shall be designed and detailed with submittal drawings and calculations sealed by a structural engineer licensed to practice in the Commonwealth of Pennsylvania.

1.5 INFORMATIONAL SUBMITTALS

A. Certificates of Conformance: Issued by a qualified testing and inspecting agency indicating that structural glued-laminated timber complies with requirements in AITC A190.1.

B. Material Certificates: For preservative-treated wood products, from manufacturer. Indicate type of preservative used and net amount of preservative retained.

C. Research/Evaluation Reports: For structural glued-laminated timber and timber connectors, from ICC-ES.

1.6 QUALITY CONTROL

A. Manufacturer Qualifications: An AITC- or APA-EWS-licensed firm

1.7 DELIVERY, STORAGE, AND HANDLING

A. General: Comply with provisions in AITC 111.

B. Individually wrap members using plastic-coated paper covering with water-resistant seams.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Division 01 Section "Quality Requirements," to design structural glued-laminated timber and connectors.

B. Structural Performance: Structural glued-laminated timber and connectors shall withstand the effects of structural loads shown on Drawings without exceeding allowable design working stresses listed in AITC 117 or determined according to ASTM D 3737 and acceptable to authorities having jurisdiction.

2.2 STRUCTURAL GLUED-LAMINATED TIMBER

A. General: Provide structural glued-laminated timber that complies with AITC A190.1 and AITC 117 or research/evaluation reports acceptable to authorities having jurisdiction.

1. Factory mark each piece of structural glued-laminated timber with AITC Quality Mark or APA-EWS trademark. Place mark on surfaces that are not exposed in the completed Work.
2. Provide structural glued-laminated timber made from solid lumber laminations; do not use laminated veneer lumber.

3. Provide structural glued-laminated timber made with wet-use adhesive complying with AITC A190.1.

B. Appearance Grade: Industrial, complying with AITC 110.

2.3 PRESERVATIVE TREATMENT

A. Preservative Treatment: Where preservative-treated structural glued-laminated timber is indicated, comply with AWPA U1, Use Category 4A.

1. Use preservative solution without[water repellents or] substances that might interfere with application of indicated finishes.
2. Do not incise structural glued-laminated timber or wood used to produce structural glued-laminated timber.

B. Preservative: One of the following:

1. Oxine copper (copper-8-quinolinolate) in a light petroleum solvent.
2. Pentachlorophenol in light petroleum solvent.
3. Copper naphthenate in a light petroleum solvent.
4. Ammoniacal zinc copper arsenate (ACZA) in a water solution.
5. Chromated copper arsenate (CCA) in a water solution.
6. Ammoniacal copper quat Type A (ACQ-C) in a water solution.
7. Propiconazole tebuconazole imidacloprid (PTI) in a water emulsion.

C. After dressing members, apply a copper naphthenate field-treatment preservative to comply with AWPA M4 to surfaces cut to a depth of more than 1/16 inch.

2.4 TIMBER CONNECTORS

A. Fabricate beam seats from stainless steel with 3/16-inch bearing plates, 3/4-inch- diameter-by-12-inch- long deformed bar anchors, and 0.239-inch side plates.

B. Fabricate arch base shoes from stainless steel with 1-inch baseplates and 3/8-inch side plates.

C. Fabricate beam hangers from stainless steel with 0.179-inch stirrups and 0.239-inch top plates.

D. Fabricate hinge connectors from stainless steel with 0.179-inch side plates and [3/4-inch] [1-inch] top and bottom plates.

E. Fabricate strap ties from stainless steel, 2-1/2 inches wide by 0.179 inch thick.

F. Fabricate tie rods from round steel bars with upset threads connected with forged-steel turnbuckles complying with ASTM A 668/A 668M.

G. Provide bolts, 3/4 inch unless otherwise indicated, complying with ASTM A 307, Grade A; nuts complying with ASTM A 563; and, where indicated, flat washers.

H. Materials: Unless otherwise indicated, fabricate from the following materials:

1. Structural-steel shapes, plates, and flat bars complying with ASTM A 36/A 36M.
2. Round steel bars complying with ASTM A 575, Grade M 1020.
3. Hot-rolled steel sheet complying with ASTM A 1011/A 1011M, Structural Steel, Type SS, Grade 33.
4. Stainless-steel plate and flat bars complying with ASTM A 666, Type 316.
5. Stainless-steel bars and shapes complying with ASTM A 276, Type 316.
6. Stainless-steel sheet complying with ASTM A 240/A 240M or ASTM A 666, Type 316.

I. Finish steel assemblies and fasteners with rust-inhibitive primer, 2-mil dry film thickness.

J. Hot-dip galvanize steel assemblies and fasteners after fabrication to comply with ASTM A 123/A 123M or ASTM A 153/A 153M.

2.5 MISCELLANEOUS MATERIALS

A. End Sealer: Manufacturer's standard, transparent, colorless wood sealer that is effective in retarding the transmission of moisture at cross-grain cuts and is compatible with indicated finish.

B. Penetrating Sealer: Manufacturer's standard, transparent, penetrating wood sealer that is compatible with indicated finish.

2.6 FABRICATION

A. Shop fabricate for connections to greatest extent possible, including cutting to length and drilling bolt holes.

1. Dress exposed surfaces as needed to remove planing and surfacing marks.

B. Camber: Fabricate horizontal and inclined members of less than 1:1 slope with either circular or parabolic camber equal to 1/500 of span.

C. Where preservative-treated members are indicated, fabricate (cut, drill, surface, and sand) before treatment to greatest extent possible. Where fabrication must be done after treatment, apply a field-treatment preservative to comply with AWPA M4.

1. Use inorganic boron (SBX) treatment for members not in contact with the ground and continuously protected from liquid water.
2. Use copper naphthenate treatment for members in contact with the ground or not continuously protected from liquid water.

D. End-Cut Sealing: Immediately after end cutting each member to final length and after preservative treatment, apply a saturation coat of end sealer to ends and other cross-cut surfaces, keeping surfaces flood coated for not less than 10 minutes.

E. Seal Coat: After fabricating, sanding, and end-coat sealing, apply a heavy saturation coat of penetrating sealer on surfaces of each unit except for preservative-treated wood where treatment included a water repellent.

2.7 FACTORY FINISHING

A. Provide manufacturer's standard stain finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates in areas to receive structural glued-laminated timber, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of the Work.

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

3.2 INSTALLATION

A. General: Erect structural glued-laminated timber true and plumb and with uniform, close-fitting joints. Provide temporary bracing to maintain lines and levels until permanent supporting members are in place.

1. Handle and temporarily support glued-laminated timber to prevent surface damage, compression, and other effects that might interfere with indicated finish.

B. Cutting: Avoid extra cutting after fabrication. Where field fitting is unavoidable, comply with requirements for shop fabrication.

C. Fit structural glued-laminated timber by cutting and restoring exposed surfaces to match specified surfacing

1. Predrill for fasteners using timber connectors as templates.
2. Finish exposed surfaces to remove planing or surfacing marks and to provide a finish equivalent to that produced by machine sanding with No. 120 grit sandpaper.
3. Coat cross cuts with end sealer.
4. Where preservative-treated members must be cut during erection, apply a field-treatment preservative to comply with AWPA M4.

    a. Use inorganic boron (SBX) treatment for members not in contact with the ground and continuously protected from liquid water.
    b. Use copper naphthenate treatment for members in contact with the ground or not continuously protected from liquid water.

D. Install timber connectors as indicated.

1. Unless otherwise indicated, install bolts with same orientation within each connection and in similar connections.
2. Install bolts with orientation as indicated or, if not indicated, as directed by Architect.

3.3 ADJUSTING

A. Repair damaged surface after completing erection. Replace damaged structural glued-laminated timber if repairs are not approved by Architect.

3.4 PROTECTION

A. Do not remove wrappings on individually wrapped members until they no longer serve a useful purpose, including protection from weather, sunlight, soiling, and damage from work of other trades.

1. Coordinate wrapping removal with finishing work. Retain wrapping where it can serve as a painting shield.
2. Slit underside of wrapping to prevent accumulation of moisture inside the wrapping.

END OF SECTION 061800

SECTION 06 62 00

PLASTIC WALL PANELING

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. SUMMARY

A. Provide fiberglass reinforced plastic (FRP) panels for wall applications.

B. Related Sections: Coordinate with work of other sections including the following:

1. Section 092900 – Gypsum Board.
2. Section 096513 – Resilient Base.

1.3. SUBMITTALS

A. Product Data: Submit manufacturer's literature including product characteristics, accessories and limitations.

B. Selection Samples: Submit samples of colors and finishes if requested by architect.

C. Verification Samples: Submit samples of selected materials specified to verify color and finish.

D. Industry Certifications and Standards: Submit copy of documentation indicating compliance.

1.4. QUALITY CONTROL

A. Manufacturer: Minimum of 5-years experience manufacturing similar products.

1.5. DELIVERY, STORAGE AND HANDLING

A. Deliver materials and products in unopened factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations.

1.6. WARRANTY

A. Manufacturer's Warranty: Provide manufacturer's standard one-year warranty against defects in manufacturing.

PART 2 - PART 2 - PRODUCTS

2.1. FIBERGLASS REINFORCED PLASTIC PANELS

A. Basis of Design Manufacturer: Fiber-Tech Industries 2000 Kenskill Ave Washington Court House, Ohio 43160 Phone: 740-335-9400 Fax: 740-335-4843 Toll Free: 800-879-4377 www.fiber-tech.net

1. Other approved manufacturers include but are not limited to: Porta-Fab, Crane Composites

B. MATERIAL

1. Basis of Design : Clad Tuff FRP/Plywood panels
2. Plywood backer panel: APA rated B-CX plywood, 5/8” thick core, plugged and touch sanded from Structural Group 1 veneers
3. Panel size: 48”x96”

PART 3 - PART 3 - EXECUTION

3.1. EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2. INSTALLATION

A. Install products in strict accordance with manufacturer’s instructions and approved submittals.

B. Clean substrate of dirt, dust, waxes, and other bond breaking substances prior to beginning installation.

C. Install panels with bottom edge located to clear top of resilient base.

D. Set FRP panels vertically in place leaving approximately 1/8 inch between panels and 1/4 inch space top and bottom.

E. Follow adhesive manufacturer’s recommendations for set and application times.

F. Provide mechanical fasteners according to manufacturer’s recommendations.

G. Provide manufacturer’s standard trim pieces and closures between panels and at all inside and outside corner transitions.

3.3. ADJUSTING AND CLEANING

A. Replace installations out of plumb and not aligned with adjacent panels and construction.

B. Clean panel face to remove soiling, stains, dust, and dirt using clean rags, and cleaning agents as instructed by manufacturer.

C. Leave installation clean, free of residue and debris resulting from work of this section.

END OF SECTION 06 62 00

SECTION 06 70 00
FIBERGLASS STAIRS

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 REFERENCES

A. ASTM D-638-Tensile Properties of Plastics
B. ASTM D-790-Flexural Properties of Unreinforced and Reinforced Plastics
C. ASTM D-2344-Apparent Interlaminar Shear Strength of Parallel Fiber Composites
D. ASTM D-696-Coefficient of Linear Thermal Expansion for Plastics
E. ASTM E-84-Surface Burning Characteristics of Building Materials
F. OSHA Code of Federal Regulations (CFR), Title 29, Section 1910.25, Section 1910.28, and Section 1910.29(b)

1.3 SUBMITTALS

A. Manufacturer's shop drawings clearly showing material sizes, types, styles, part or catalog numbers, complete details for the fabrication of and erection of components including, but not limited to, location, lengths, type and sizes of fasteners, clip angles, member sizes, and connection details.

B. Manufacturer’s published literature including structural design data, structural properties data, corrosion resistance tables, certificates of compliance, test reports as applicable, and design calculations for systems not sized or designed in the contract documents, sealed by a Professional Engineer.

1.4 QUALITY CONTROL

A. All items to be provided under this Section shall be furnished only by manufacturers having a minimum of ten (10) years experience in the design and manufacture of similar products and systems. Additionally, if requested, a record of at least five (5) previous, separate, similar successful installations in the last five (5) years shall be provided.

B. Manufacturer shall offer a 3 year limited warranty on all FRP products against defects in materials and workmanship.

C. Manufacturer shall be certified to the ISO 9001 standard.

D. Manufacturer shall provide proof of certification from at least two other quality assurance programs for its facilities or products (DNV, ABS, USCG, AARR).

E. Delegated design: Manufacturer shall provide all product engineering and design details, including fully dimensioned fabrication drawings for approval prior to manufacturing.

   a. Shop drawings shall be based on actual field-verified dimensions after the concrete walls and slabs of the brine containment facility have been poured and cured.

1.5 PRODUCT DELIVERY AND STORAGE

A. Delivery of Materials: Manufactured materials shall be delivered in original, unbroken pallets, packages, containers, or bundles bearing the label of the manufacturer. Adhesives, resins and their catalysts and hardeners shall be crated or boxed separately and noted as such to facilitate their movement to a dry indoor storage facility.

B. Storage of Products: All materials shall be carefully handled to prevent them from abrasion, cracking, chipping, twisting, other deformations, and other types of damage. Adhesives, resins and their catalysts are to be stored in dry indoor storage facilities between 70 and 85 degrees Fahrenheit (21 to 29 degrees Celsius) until they are required.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Basis of Design manufacturer: Fibergrate Composite Structures Inc.
   5151 Belt Line Road, Suite 1212
   Dallas, Texas 75254-7028 USA
   (800) 527-4043 Phone (972) 250-1530 Fax
   Website: www.fibergrate.com
   E-mail: info@fibergrate.com

B. Other acceptable manufacturers:
   1. Ultra Fiberglass Systems
   2. Wagner Enterprises

C. Other manufacturer as approved by Architect.

2.2 GUARDRAILS AND STRUCTURAL SHAPES

A. All structural members, posts and rails are to be structural shapes manufactured by the

pultrusion process. The structural shapes shall be composed of fiberglass reinforcement and resin in qualities, quantities, properties, arrangements and dimensions as necessary to meet the design requirements and dimensions specified in the Contract Documents.

B. Fiberglass reinforcement shall be a combination of continuous roving, continuous strand mat, and surfacing veil in sufficient quantities as needed by the application and/or physical properties required.

C. Resins shall be fire retardant isophthalic polyester with chemical formulation necessary to provide the corrosion resistance, strength and other physical properties as required.

D. All finished surfaces of FRP items and fabrications shall be smooth, resin-rich, free of voids and without dry spots, cracks, crazes or unreinforced areas. All glass fibers shall be well covered with resin to protect against their exposure due to wear or weathering.

E. All pultruded structural shapes shall be further protected from ultraviolet (UV) attack with 1) integral UV inhibitors in the resin. Guardrails and handrails located outdoors shall be shop coated with a 2 part polyurethane coating, a minimum of 2 mils thick, for improved durability and UV resistance.

F. All FRP products shall have a tested flame spread rating of 25 or less per ASTM E-84 Tunnel Test.

G. Top and bottom rails for guards are to be 1.75" x 0.125" (44.4 mm x 3.2 mm) wall square tube, the posts are to be 2.125" x 0.1875" (53.9 mm x 4.8 mm) wall square tube and kick plate is to be ½" deep x 4" wide with two reinforcing ribs. Offset rail used as handrail to be 1.5” x 0.25” (38.1 mm x 6.4 mm) wall round tube.

H. The completed railing installation shall meet the following load requirements with a minimum factor of safety of 2.0:

1. Concentrated Load: 200 lb (891 N) applied in any direction at any point on the rail.
2. Uniform Load: 50 lb/lf (730.5 N/m) applied in any direction on the rail.
3. Loads are assumed not to act concurrently.

I. All rails, posts, and kick plates are to be integrally pigmented yellow. All other structural members to be integrally pigmented dark grey.

J. Pultruded structural shapes used in the railing systems are to have the minimum longitudinal mechanical properties listed below:

Property	**ASTM Method**	**Value**	**Units**
Tensile Strength	D-638	30,000 (206)	psi (MPa)
Tensile Modulus	D-638	2.5 x 10^6 (17.2)	psi (GPa)
Flexural Strength	D-790	30,000 (206)	psi (MPa)

Flexural Modulus	D-790	1.8×10^6 (12.4)	psi (GPa)
Flexural Modulus (Full Section)	N/A	2.8×10^6 (19.3)	psi (GPa)
Short Beam Shear (Transverse)	D-2344	4,500 (31)	psi (MPa)
Shear Modulus (Transverse)	N/A	4.5×10^5 (3.1)	psi (GPa)
Coefficient of Thermal Expansion	D-696	8.0×10^{-6} (1.4×10^{-6})	in/in/°F (cm/cm/°C)
Flame Spread	E-84	25 or less	N/A

K. All fasteners used in the railing system are to be 316 SS. Rivets to be 18-8 SS.
L. Color: As selected by Architect from manufacturer's full range.

2.3 MOLDED FRP GRATING

A. Manufacture: Grating shall be of a one piece molded construction with tops and bottoms of bearing bars and cross bars in the same plane. Grating shall have a square mesh pattern providing bidirectional. Grating shall be reinforced with continuous rovings of equal number of layers in each direction. The top layer of reinforcement shall be no more than 1/8" below the top surface of the grating so as to provide maximum stiffness and prevent resin chipping of unreinforced surfaces. Percentage of glass (by weight) shall not exceed 35% so as to achieve maximum corrosion resistance, and as required to maintain the structural requirements of the Contract. After molding, no dry glass fibers shall be visible on any surface of bearing bars or cross bars. All bars shall be smooth and uniform with no evidence of fiber orientation irregularities, interlaminar voids, porosity, resin rich or resin starved areas.

B. Non–slip surface (select one): Grating shall be manufactured with a concave, meniscus profile on the top of each bar providing maximum slip resistance.

C. Grating bar intersections are to be filleted to a minimum radius of 1/16" to eliminate local stress concentrations and the possibility of resin cracking at these locations.

D. Fire rating: Grating shall be fire retardant with a tested flame spread rating of 25 or less when tested in accordance with ASTM E 84. Data performed only on the resin shall not be acceptable.

E. Resin system: manufacturer recommendation.

F. Manufacturer may be required to submit corrosion data from tests performed on actual grating products in standard chemical environments. Corrosion resistance data of the base resin from the manufacturer is not a true indicator of grating product corrosion resistance and shall not be accepted.

G. Color: As selected by Architect from manufacturer's full range.

H. Depth: 1"with a tolerance of plus or minus 1/16".

I. Mesh Configuration: 1.5" x 1.5" with a tolerance of plus or minus 1/16" mesh centerline to

centerline.

J. Load/Deflection: Grating design loads shall be less than manufacturers published maximum recommended loads. Maximum recommended loads shall be determined by acoustic emission testing. Grating shall be designed for a uniform load of 100 psf or concentrated load of 300 lb. Deflection is not to exceed 0.375" or L/D = 120, whichever is less.

K. The manufacturer shall certify that the stiffness of all panels manufactured are never more than 2.5% below the published load-deflection values.

L. Hardware: Type 316 stainless steel hold-down clips shall be provided and spaced at maximum of four feet apart with a minimum of four per piece of grating, or as recommended by the manufacturer.

2.4 STAIR TREADS

A. Manufacture: Stair treads shall be of a one-piece molded construction and shall have a 1-1/2" x 6" rectangular mesh pattern providing unidirectional strength in the tread span direction. Tread shall be reinforced with continuous rovings in each direction. The top layer of reinforcement shall be no more than 1/8" below the top surface of the tread so as to provide maximum stiffness and prevent resin chipping of unreinforced surfaces. Percentage of glass (by weight) shall not exceed 35% so as to achieve maximum corrosion resistance, and as required to maintain the structural requirements of the Contract. After molding, no dry glass fibers shall be visible on any surface of bearing bars or cross bars. All bars shall be smooth and uniform with no evidence of fiber orientation irregularities, interlaminar voids, porosity, resin rich or resin starved areas.

B. Non-slip surfacing: Stair treads shall be manufactured with a concave, meniscus profile on the top of each bar providing maximum slip resistance. For additional safety, and to meet OSHA requirements, stair treads shall be manufactured with a 1-1/2" solid, molded nosing. Nosing shall be gritted with an angular quartz grit, integrally molded into the top surface of the nosing area only.

C. Fire rating: Stair treads shall be fire retardant with a tested flame spread rating of 25 or less when tested in accordance with ASTM E 84. Test data performed only on the resin shall not be accepted.

D. Resin system: The resin system used in the manufacture of stair treads shall be manufacturer standard. Manufacturer may be required to submit corrosion data from tests performed on actual stair tread products in standard chemical environments. Corrosion resistance data of the base resin from the manufacturer is not a true indicator of stair tread product corrosion resistance and shall not be accepted.

E. Thickness: 1-1/2" thick with a tolerance of plus or minus 1/16".

F. Mesh Configuration: 1-1/2" x 6" rectangular mesh pattern with double cross bars on 6" centers which allows optimum utilization and ease of fabrication.

G. Color: As selected by Architect from manufacturer's full range.

H. Load/Deflection: Stair treads shall meet manufacturer's published recommended loading with deflection not to exceed the following:

1. Concentrated load of 500 pounds, placed at the centerline of a 36" tread span with a maximum deflection not to exceed 0.32".
2. The concentrated load is applied at the centerline of the tread, over a width of 4" and a depth of 6", starting at the nosing edge to simulate the landing of a foot.

F. The manufacturer shall certify that the stiffness of all panels manufactured are never more than 2.5% below the published load-deflection values.

PART 3 - EXECUTION

3.1 INSPECTION

A. Contractor shall field verify all dimensions and conditions prior to fabrication.

3.4 INSTALLATION

A. Contractor shall install walkover platforms in accordance with manufacturer’s assembly drawings. The contractor shall ascertain that plumbness, level and alignment are within acceptable tolerances. Fasten grating panels securely in place with hold-down fasteners as specified herein. Field cut and drill fiberglass reinforced plastic products with carbide or diamond tipped bits and blades. Seal cut or drilled surfaces in accordance with manufacturer's instructions. Follow manufacturer's instructions when cutting or drilling fiberglass products or using resin products; provide adequate ventilation.

END OF SECTION 06 70 00

SECTION 07 10 00

UNDERSLAB VAPOR BARRIER AND DAMPPROOFING

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. SCOPE

A. Vapor Barrier and Dampproofing shall be continuous, interconnected, unbroken over the required surfaces and shall be installed in proper sequence to other work to produce a waterproof and leakproof application. All work shall be installed in accordance with the manufacturer's current printed directions and specifications as approved by the Architect.

1.3. SUBMITTALS

A. Samples: Provide 12" x 12" samples of vapor barrier material to the Architect before delivery to the job site.

1.4. SITE CONDITIONS

A. Inspection: Before starting any work, examine all surfaces to which, or against which, materials are to be applied to be assured that the surfaces are clean and suitable to receive the work. Report any deviations to Architect for correction.

1.5. PRODUCT HANDLING

A. Delivery and Storage: Protect materials from weather and moisture.

PART 2 - PRODUCTS

A. Underslab Vapor Barrier: Use virgin polyethylene or polyolefin products along with seaming materials furnished by the same company as vapor barrier.

1. Acceptable Products.
    a. W.R. Meadows, Perminator, 15 mil thickness
    b. Stego Industries, Vapor Barrier, 15 mil thickness
    c. Poly America L.P., Husky Yellow Guard, 15 mil thickness
    d. Or equal as approved by the Professional

B. Dampproofing: To be Cold-Applied, Emulsified-Asphalt for masonry cavity walls with concrete or masonry back-up walls and below grade walls exposed to soil where waterproofing is not specified.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Karnak Corporation. AF100 Non-Fibered Emulsion
    b. W.R. Meadows Sealmastic Emulsion

c. EP Henry Company, 788 Non-Fibered Emulsion
d. Or approved equal

3. Trowel Coats: ASTM D 1227, Type II, Class 1.
4. Fibered Brush and Spray Coats: ASTM D 1227, Type II, Class 1.
5. Brush and Spray Coats: ASTM D 1227, Type III, Class 1.
6. VOC Content: 0.25 lb/gal. or less
7. Provide manufacturers recommended fabric reinforcing at joints.

C. Fluid Applied Weather Resistive Barrier: Provide on exterior walls in accordance with Section 07 28 00.

D. Provide waterproofing membrane where noted for specific conditions.

PART 3 - EXECUTION

3.1. EXTERIOR DAMPPROOFING FOR CONCRETE AND MASONRY

A. Location: Required on the faces (each side of wall) exterior of new concrete and concrete masonry foundation walls not receiving waterproofing.

1. Concrete masonry foundations shall have dampproofing applied on each side of exposed masonry to prevent moisture wicking vertically in wall where waterproofing is not installed.

B. Surfaces: Thoroughly brush down walls to be dampproofed. If traces of adhering earth remain, hose down walls to clean and allow wall to dry thoroughly before applying dampproofing.

C. Application: Dampproofing mastic shall be applied to obtain a heavy, continuous coating at least 1/16" thick, filling all irregularities in accordance with directions of the manufacturer from bottom of footing across top of footing then up wall to finished grade. Upon completion, the dampproofing shall be inspected by the Architect to see that it is uniform in thickness, free of pinholes, skips or voids. Allow dampproofing to dry for a minimum of 48 hours before backfilling.

3.2. UNDERSLAB VAPOR BARRIER MEMBRANE

A. Location: Required under new interior slabs on grade.

B. Application: All new concrete floor slabs on crushed stone base shall be preceded by one ply of vapor barrier placed in position immediately before pouring of concrete. Lap all side edges 6” and ends 12”. Patch any holes and rips in film to satisfaction of Architect. Turn up vapor barrier 3” at walls against expansion joint material. Coordinate placement with the insulation specified.

C. At Walls: Membrane shall be carried up the walls to top of finished concrete slab.

D. Place, protect and repair sheet vapor barrier in accordance with ASTM E1643 and manufacturer’s written instructions.

3.3. DAMPPROOFING

A. Location: Provide typically to be provided in masonry cavity walls at below grade portions of masonry and concrete walls exposed to soil where waterproofing is not specified/noted.

1. Dampproofing to also to applied to the back of cavity wall rigid insulation and used as adhesive for cavity wall rigid insulation in below grade areas.

B. Surface preparation: Parge honeycombing in concrete and tool mortar joints before application. Comply with manufacturer's recommendations.

C. All joints shall be filled and sealed before application of damp proofing as well.

D. Application: Spray or Roll-on.

1. Confirm that the application has gone into all recesses and crevices before moving on to other areas. Reapply material until surfaces are completely covered.

END OF SECTION 07 10 00

SECTION 07 21 00

THERMAL INSULATION

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.1. SUMMARY

A. Section Includes:

1. Foam-plastic board insulation.
2. Glass fiber blanket insulation.
3. Blown-in cellulose insulation.
4. Insulation accessories.

1.2. SUBMITTALS

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

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

C. Research/Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.3. QUALITY CONTROL

A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.4. DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1. FOAM-PLASTIC BOARD INSULATION

A. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV and minimum compressive strength of 25 psi, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84. Provide with tongue and groove and/or shiplap long edges features.

1. This type of insulation for wall types in locations as indicated on drawings.
2. 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. Dow Chemical Company.
    b. Owens Corning.
    c. Pactiv Building Products.
    d. Or equal product as approved by Architect.

B. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

2.2. GLASS-FIBER BLANKET INSULATION

A. The requirements for glass-fiber blanket insulation is specified as a standard in order to establish a standard of quality for where existing fiberglass blanket insulation may require cutting and patching within existing wall assemblies being affected by renovations.

B. Glass-fiber blanket insulation shall be provided in exterior wall locations in thicknesses as indicated on the drawings.

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

1. CertainTeed Corporation.
2. Guardian Building Products, Inc.
3. Johns Manville.
4. Knauf Insulation.
5. Owens Corning.

D. Provide glass-fiber blanket insulation as follows:

1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
2. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.

2.3. BLOWN IN CELLULOSE INSULATION

A. Basis of Design Manufacturer: Fiberlite Technologies, Inc. 3605 E. 25th St. Joplin, Missouri 64804 www.fiberlitetech.com

1. Other acceptable manufacturers include Knauf, Johns Manville or other manufacturer as approved by Architect.

B. Product: SATAC spray applied thermal cellulose insulation

1. 80% paper fiber content
2. Treated fibers for permanent flame resistance
3. Does not contain asbestos, mineral fibers, formaldehyde or ammonium based additives.
4. Non-toxic, non-corrosive, insect resistant.
5. Color : Gray.
6. ASTM E-84
    a. Flame spread 5
    b. Smoke developed 15
7. Non corrosive per HUD UMB #80 and ASTM C-739.
8. ASTM E-73 1.36 psi
9. Complies with CPSC 16 CFR and ASTM C-1149.

2.4. AUXILIARY INSULATING MATERIALS

A. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates. Use Karnac 100 as manufactured by Karnac, Clark, New Jersey, or equal as approved by Architect. Apply to block at the rate of 2 to 3 gallons per 100 square feet. Product shall comply with ASTM D-1187, Type B.

1. Product to serve as adhesive and vapor barrier as well on masonry and concrete back-up walls.

PART 3 - EXECUTION

3.1. EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for Sections in which substrates and related work are specified and other conditions affecting performance.

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

3.2. PREPARATION

A. Clean substrates of substances harmful to insulations or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

3.3. INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice and snow.

C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Water-Piping Coordination: If water piping is located on inside of insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.

E. Apply single layer of insulation to produce thickness indicated, unless multiple layers are otherwise shown or required to make up total thickness.

3.4. INSTALLATION OF PERIMETER AND UNDER-SLAB INSULATION

A. All foundation walls around the exterior perimeter of new building construction shall receive extruded polystyrene insulation board cemented to the vertical inside face of foundation wall down to the top of footing. Provide horizontal sections of additional insulation below the vapor barrier if indicated for specific conditions. Thickness of insulation shall be as noted on the drawings.

1. If not indicated on drawings, extend insulation to the top of foundation footings, typical.

B. Rooms at perimeter of building with floor slabs on grade shall be isolated from exterior walls with ½" rigid insulation, unless otherwise detailed differently with thicker insulation at specific conditions.

C. Exterior wall insulation in cavity walls shall continue to top of footing elevation below to thermally isolate interior slabs on grade from exterior soil temperature. Provide insulation thickness as noted on drawings.

D. On vertical surfaces, set units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer.

3.5. INSTALLATION OF BLOWN IN CELLULOSE INSULATION

A. Install in full accordance with manufacturer's written instructions and best industry practice.

B. Apply insulation to value of R-38.

C. Provide natural or mechanical ventilation to properly cure insulation.

3.6. INSTALLATION OF GENERAL BUILDING INSULATION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units. Provide all fasteners and accessories.

B. Seal joints between closed-cell (nonbreathing) insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

C. Set vapor-retarder-faced units with vapor retarder to warm side of construction, unless otherwise indicated. Do not obstruct ventilation spaces, except for firestopping.

D. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.

E. Provide mineral wool insulation in all framed partitions, typical, and as noted for detailed conditions.

3.7. PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 21 00

SECTION 07 41 13
METAL ROOF PANELS

PART 1 GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Scope of Work: Contract Drawings indicate extent and general configuration of roof. Provide materials for and install complete roof system including, but not limited to:
   1. Metal roofing panels.
   2. Underlayments.
   3. Fasteners and attachment devices.
   4. Flashings and other accessories.

B. Related Work Specified In Other Sections:
   1. Section 061600 - Sheathing
   2. Section 076000 – Flashing and Sheet Metal

1.3 REFERENCES

A. Aluminum Association: Publication 35: Specifications for aluminum sheet metal work in building construction.
B. ASTM B209 – Aluminum and Aluminum-Alloy Sheet and Plate.
C. Underwriters Laboratory: Building Materials Directory.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Design: Comply with design criteria.
B. Watertightness: No uncontrolled water leakage shall occur through roof system.
C. Wind Uplift: FM I-90
D. Material Compatibility: Prevent contact between dissimilar metals and between metals and potentially corrosive or staining substances.
E. Expansion and Contraction: Shall be installed to accommodate thermal expansion and contraction.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's specifications, standard detail drawings and installation instructions.

1.6 SHOP DRAWINGS

A. Submit shop drawings indicating thickness and dimensions of parts, fastenings and anchoring methods.
B. Indicate roof terminations, clearly showing flashings and change of direction.
C. Clearly indicate locations of field-applied sealant.
D. Show locations of nailing clips and fasteners.
E. Provide a plan showing layout of entire roof.

1.7 SAMPLES

A. Submit two 12” x 12” sample panels showing metal thickness, profile and required finish.
B. Submit standard color samples on metal for Architect's selection.

1.8 QUALITY CONTROL

A. Manufacturer's Qualifications:
B. Twenty years minimum experience in factory fabrication of metal roofing systems.
C. Installer’s Qualifications: Installer shall provide necessary manpower and equipment to assure progress of work in accordance with Project schedule. Installer shall employ a foreman on Project site who shall have a minimum of five years experience installing similar products on comparable projects.

1.9 DELIVERY, STORAGE AND HANDLING

A. Comply with manufacturer’s delivery, storage and handling instructions.
B. Schedule deliveries to assure continuous progress of work.
C. Protect products against damage.
D. Store under waterproof covering, with proper ventilation to prevent condensation.
E. Inspect materials upon arrival at site and note damaged materials. Do not install damaged materials.
F.
G. Verify access limitations to site and roof. Verify that materials proposed to be stored or staged on roof do not exceed structural limitations of building.

1.7 SEQUENCE AND SCHEDULING

A. Schedule work of this Section to avoid impeding work of other sections.

1.8 WARRANTY

A. Furnish manufacturer's standard limited transferable warranty stating architectural fluorocarbon finish will be:
   1. Free of fading or color change in excess of 5 NBS units as measured per ASTM D2244 for a period of 20 years.
   2. Will not chalk in excess of numerical rating of 8 when measured in accordance with standard procedures specified in ASTM D659 for a period of 20 years.

B. Furnish written warranty signed by applicator for five-year period from date of substantial completion of building covering repairs required to maintain roof and flashings in watertight conditions.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Basis of Design Product: ClickLock aluminum roofing system as manufactured by Classic Products, Inc., Piqua, OH, Tel. 1-800-543-8938.
   1. Color: Mustang Brown

B. Other acceptable manufacturers:
   1. Fabral. Color Dark Bronze
   2. MBCI. Color Medium Bronze
   3. MS Metal Sales. Color Dark Brown or Mansard Brown
   4. Reed's Metals. Color Cocoa Brown
   5. Other manufacturer and color as approved by Architect.

2.2 MATERIALS

A. Panels:
   1. Provide factory-formed interlocking panels produced from .032" thick aluminum alloy 3105.
   2. Factory fabricated panels with integral continuous interlocking standing seam, without the need for separate seam covers.
   3. Seam size:
      a. Male leg: 1 5/8" high.
      b. Female leg: 1 3/4" high x 3/8" wide.

2.3 ACCESSORIES

A. General: Accessories shall be as recommended by roof system manufacturer to meet performance criteria.

B. Underlayment:
   1. Basis of Design: One layer 30 lb. asphalt felt; ASTM D226; or one layer RoofTopGuard II poly-based underlayment.
   2. Or other underlayment as approved by roof panel manufacturer.

C. Flashing:
   1. Flashings shall provide for positive drainage, prevent ponding of water, and allow moisture to drain off roof without affecting underlying construction. Flashing to prevent capillary action.
   2. Flashings utilizing pop rivets must be self-sealing or sealed with sealant and always be above line of water flow.

D. Penetration Seals:
   1. Round Penetrations: Flash with aluminum and neoprene pipe boots.
   2. Rectangular Openings: Flash with flashings compatible with roof system.

E. Snow Retention Devices: Provide snow retention devices approved by roof manufacturer for use with roof system.

F. Fasteners:
   1. Fasten with 18 gauge 1 7/8" stainless steel clips provided by the roof system manufacturer. Clips are spaced every 12", and each clip is secured to the deck with two fasteners.
   2. Provide fasteners of sizes and types required by Project conditions to meet performance specifications and roof manufacturer's recommendations. Fasteners shall be corrosion resistant and compatible with roofing and other materials.
   3. Pop Rivets: Provide non-corroding, not-staining type. They shall be sealed and located above flow of water. Rivets shall have a minimum shank diameter of 0.125 inches and shall be of sufficient length to form a proper head.

G. Sealants:
   1. Sealants shall be color-matched butyl rubber sealant provided by roof system manufacturer, non-corrosive and compatible to adjacent material.
   2. Seal with cartridge-type sealant.
      a. Sealants shall remain fluid.
      b. Sealants shall adhere to panel surfaces. Clean panels that may be lightly coated with lubricants or airborne contaminants. Sealants must be compatible with contiguous materials.
      c. Sealants should be applied only to dry surfaces.

2.5 FINISHES

A. PVDF painted.
   1. Pretreatment: Metal shall undergo continuous cleaning, rinsing, and chemical conversion process immediately prior to painting.
   2. Exterior Coat:
      a. Primer coat shall be 0.2 mil minimum average thick, fully cured, and corrosion resistant and flexible base for topcoat.
      b. Topcoat shall yield a 0.7 mil minimum average thick coating. Topcoat shall be fully cured and of consistent color throughout Project.

c. Adhesion:
    i. Bend Test: 1/8" mandrel, no tape pull-off per ASTM D522.
    ii. Reverse Impact: 3 x metal thickness per ASTM D2794.
d. Corrosion Resistance:
    i. Salt Spray: 1000 hours per ASTM B117.
e. Accelerated Weathering: 2000 hours per ASTM G23 or ASTM G26.
f. Weatherability: 5 year South Florida or equivalent exterior exposure:
    i. Color Retention: 5 AEE units maximum degradation per ASTM D2244.
    ii. Chalk resistance: 8 minimum rating per ASTM D4214.

3. Gloss Retention: 75% minimum retention per ASTM D523.
4. Back Coat: Corrosion resistant primer plus wash coat, 0.7 mil minimum average total dry thickness.

2.6 FABRICATION TOLERANCES

A. Panel Construction: Uniformly dimensioned. Clips and fasteners shall be concealed.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrate to ensure it is solid and smooth.
B. Do not commence installation until field conditions have been verified.
C. Ensure cuttings from field fabrication are removed prior to installation.

3.2 PREPARATION

A. Field measure prior to fabrication of custom fabricated items.
B. Lay out work to provide symmetrical appearance. Where field cutting is required, make cuts in a workmanlike manner.
C. Protection:
    1. Adjacent surfaces: When possible, install flashings prior to siding and stucco installation.
    2. Dissimilar metals: Isolate any dissimilar metals to prevent corrosion.

3.3 INSTALLATION

A. General: Comply with approved shop drawings, manufacturer's installation instructions, and applicable construction and safety regulations.
B. Underlayment: Install underlayment according to procedures recommended by roof system manufacturer.
C. Panels shall be interlocked with each other and securely attached to the roof deck.

D. Flashings:
   1. Follow approved details.
   2. Flashings shall be lapped four inches and fastened 12 inches on center.
   3. Lap valley minimum of six inches.
   4. Allow for expansion and contraction of lineal accessories.

E. Protective Materials: Provide temporary protective materials if needed to protect previously installed roof surfaces.
F. Sealants:
   1. Apply only to dry surfaces in accordance with sealant and roof manufacturer's instructions.
   2. Apply only in bend thickness of minimum 3/8".
   3. Apply in workmanlike manner.
   4. Install sealants only when ambient temperature and conditions are in accordance with sealant manufacturer's recommendations.

G. Accessories: Securely install in accordance with manufacturer's instructions.

3.4 ADJUSTING, CLEANING, AND PROTECTION

A. Protect roof from damage by work of other sections on, above, or adjacent to roof.
B. Installed panels and accessories shall be secured before leaving roof area at end of day.
C. Keep installed roof clean and protected from damage.
D. Clean gutters of roof installation debris at completion.
E. Repair minor damage to finishes. Use matching coatings recommended by roof manufacturer. Remove and replace items which can not be satisfactorily repaired.
F. Protect roofing from metal filings or shavings. Metal filings or shavings shall be cleaned from panels or flashing surfaces by end of each day.

END OF SECTION 07 41 13

SECTION 07 46 33
VINYL SIDING

PART 1 GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SECTION INCLUDES

A. Solid vinyl siding.

B. Vented vinyl soffit.

C. Vinyl trim.

1.3 RELATED SECTIONS

A. Section 07 22 80 – Nailbase Insulation Wall Panels

B. Section 07 28 00 – Fluid Applied Weather Resistive Barrier

1.4 REFERENCES

A. ASTM D 256 - Standard Test Method for Determining the Pendulum Impact Resistance of Notched Specimens of Plastics.

B. ASTM D 635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position.

C. ASTM D 638 - Standard Test Method for Tensile Properties of Plastics.

D. ASTM D 648 - Standard Test Method for Deflection Temperature of Plastics Under Flexural Load.

E. ASTM D 696 - Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 Degrees C. and 30 Degrees C.

F. ASTM D 1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

G. ASTM D 2843 - Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics.

H. ASTM D 3679 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Siding.

I. ASTM D 4477 - Standard Specification for Rigid Unplasticized Poly(Vinyl Chloride) (PVC) Soffit.

J. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

K. ASTM E 119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2000.

1.5 DESIGN / PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Code compliance in accordance with the following:
   1. ICC Evaluation Service.

1.6 SUBMITTALS

A. Submit under provisions of Division 1.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
   4. Maintenance and care requirements.

C. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

D. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

E. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

1.7 QUALITY CONTROL

A. Installer Qualifications: Provide installer with not less than three years of experience with products specified.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store on a flat surface under cover, stacked no more than 12 boxes high. Do not store in location where temperatures may exceed 130 degrees F.

1.9 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.10 WARRANTY

A. Provide manufacturer's standard limited lifetime warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Manufacturer: Mastic by Ply Gem, 2600 Grand Blvd. Suite 900; Kansas City, MO 64108 ; Toll Free Tel: 800-962-6973 or (800) 788-1964; Fax: 866-656-1900; Web:https://www.plygem.com/wps/portal/home/brands/mastic

B. Other acceptable manufacturers include Certainteed, Owens Corning, Gentek or other manufacturer as approved by Architect.

C. Requests for substitutions will be considered in accordance with provisions of Division 1.

2.2 MATERIALS

A. Siding General Requirements: Polyvinyl chloride products with the following characteristics:
   1. Siding: Comply with ASTM D 3679, Class 2.
   2. PVC cell classification in accordance with ASTM D 1784: 13334.
   3. Coefficient of linear expansion in accordance with ASTM D 696: 0.000029 inch per inch per degree F.
   4. Tensile strength when tested in accordance with ASTM D 638: Minimum 7,100 pounds per square inch.
   5. Modulus of elasticity when tested in accordance with ASTM D 638: Minimum 360,000 pounds per square inch, average.
   6. Izod impact, standard 1/8 inch bar when tested in accordance with ASTM D 256: 3.30 foot-pounds per inch, average.
   7. Shore D Hardness: Minimum 73.
   8. Specific Gravity: Minimum 1.39.
   9. Deflection temperature when tested in accordance with ASTM D 648: 170 degrees F, 264 pounds per square inch.
   10. Smoke density rating when tested in accordance with ASTM D 2843: 48 percent, average.
   11. Horizontal flammability, when tested in accordance with ASTM D 635:
      a. Burn distance: 20 mm.
      b. Burn time: Less than 5 seconds.
   12. Surface burning characteristics when tested in accordance with ASTM E 84: Flame spread less than 20, fuel contribution 0, smoke density 400.
   13. Fire Resistance - Siding: 1 hour, when tested in accordance with ASTM E 119, with siding applied over gypsum sheathing.
   14. Flammability - Siding: Comply with requirements of UBC Std 26-9.
   15. Structure Insulation System, foamed backed siding with EPS foam backing has a Permeability Rating of 5.

B. Fasteners: Aluminum nails, alloy 5056 or 6110, having minimum tensile strength 63,000 pounds per square inch.

2.3 VINYL SIDING AND TRIM

A. Vinyl Siding Type : Ovation Siding.
   1. Product Description: Double 4 profile, 8 inches exposure; nominal 0.042 inch material thickness; nominal 12 feet 6 inch piece length. Cedar Woodgrain texture.

2. Nailing Hem: Rolled, with elongated nailing holes 1-1/4 inches long at 1-5/8 inches on center.
3. Color: As selected from manufacturer's full range of available colors
4. Universal Outside Corner Post: 4 inches by 4 inches post, 3/4 inch wide siding recess.
5. J-Trim: Channel, 1-3/4 inches nailing leg, 3/4 inch forward leg, 7/8 inch channel width
6. Finishing Trim: 1-1/2 inches nailing leg, 3/4 inch forward leg
7. Wide Window Casing: 3-1/2 inches nailing leg, 2-1/2 inch forward leg with 1-1/4 inch return; white color.
8. Starter Strip: Single-row nailing hem with elongated nailing holes 1-1/4 inches long 1-5/8 inches on center, 1/4 inch base projection; white color.
9. Color : Tan.

2.4 VINYL TRIM

A. Vinyl Trim:
1. Soffit J-Trim: Channel, 1-1/2 inches nailing leg, 3/4 inch forward leg, 1/2 inch channel width.
2. Soffit J-Trim: Channel, 1-3/4 inches nailing leg, 1 inch forward leg, 5/8 inch channel width.
3. T-Channel: 1-3/4 inches batten, 5/8 inch recess.
4. Frieze Runner F-Channel.
5. Pro-Bead Soffit J-Trim: Channel, 2-3/8 inch nailing leg, 1-3/8 inch forward leg, 3/8 inch channel width.
6. Color : Tan.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared. Verify dimensions and acceptability of substrate

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Installation of vapor retarder is specified in Section 07 26 00.

C. Attach vinyl products to substrate for weathertight installation; ensure that horizontal components are installed true to level, that vertical components are installed true to plumb.

D. Stagger lap joints in horizontal siding in uniform pattern as successive courses of siding are installed.

E. Install joint sealers are specified in Section 07 90 00.

3.4 ADJUSTING AND CLEANING

A. Clean dirt from surface of installed products, using mild soap and water.

B. After completing installation, remove from project site excess materials and debris resulting from installation of vinyl products.

3.5 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 07 46 33

SECTION 07 60 00

FLASHINGS AND SHEET METAL

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. RELATED DOCUMENTS

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

B. Section 06 10 00 Rough Carpentry.

C. Section 07 54 23 TPO Roofing System.

1.3. SUMMARY

A. Section Includes:

1. Fabricated sheet metal items, including flashings, counterflashings, gutters, downspouts, snowguards and underlayment.

1.4. RELATED WORK SPECIFIED ELSEWHERE

A. Termination bars are specified in Division 7 Sections.

B. Unless specified otherwise, where vent pipes and stacks pass through roofing, the flashings for these items will be furnished by the respective HVAC, Plumbing, or Electrical Contractor.

1. General Contractor to coordinate and install such penetration flashings in order to assure proper roofing weatherization, positive drainage and warranty compliance.

1.5. SCOPE

A. The extent of each type of flashing and sheet metal work is indicated on the drawings and by provisions of this section.

1.6. SITE CONDITIONS

A. Inspection of Surfaces: Contractor shall inspect the substrates to which the work of this section adjoins. The contractor shall be responsible for field checking all dimensions, elevations and slopes on the connecting work affecting the work of this section to insure a proper fit and weathertight construction.

B. Job Conference: Before fabricating and applying any sheet metal work, a job conference shall be called with the sheet metal applicator; General Contractor and the Architect present to assure that these specifications are thoroughly understood. The contractor shall inspect roofing and other adjoining surfaces to see that all subbases and cants are firm, smooth, dry and finished correctly. If any condition exists which would prevent satisfactory work, notify the Architect immediately.

1.7. REFERENCE STANDARDS

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2014 (2015 Errata).

B. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2015.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

D. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).

E. ASTM B101 - Standard Specification for Lead-Coated Copper Sheet and Strip for Building Construction; 2012.

F. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

G. ASTM B370 - Standard Specification for Copper Sheet and Strip for Building Construction; 2012.

H. ASTM B749 - Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products; 2014.

I. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014a.

J. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2009.

K. ASTM D2178/D2178M - Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing; 2015a.

L. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2012).

M. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.8. SUBMITTALS

A. Shop Drawings: Except flashings made from prefinished coiled material, submit shop drawings to the Architect for review. Shop drawings shall be in accordance with the General Conditions.

B. Samples: Samples of finish shall be submitted to the Architect for approval upon request. In the case of special finishes, these samples shall show extremes from light to dark within the allowable commercial tolerances. All materials installed shall fall within the range of the approved samples. Samples shall be clearly identified as to project and type of finish.

1.9. QUALITY CONTROL

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.

1.10. DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

1.11. WARRANTY

A. Finish shall be warranted for twenty years against fading, cracking and peeling.

1.12. PERFORMANCE REQUIREMENTS

A. Metal Roof Edging and Fascia: Continuous metal edge member serving as termination of roof membrane and retainer for metal fascia; watertight with no exposed fasteners; mounted to roof edge nailer.

1. Wind Performance:
   a. Membrane Pull-Off Resistance: 100 lbs/ft (1460 N/m), minimum, when tested in accordance with ANSI/SPRI ES-1 Test Method RE-1, current edition.
   b. Fascia Pull-Off Resistance: At least the minimum required when tested in accordance with ANSI/SPRI ES-1 Test Method RE-2, current edition.
2. Provide product listed in current Factory Mutual Research Corporation Approval Guide with at least FM 1-270 rating.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

A. Acceptable sheet metal manufacturers include Pac-Clad, Ply-Gem, ATAS or other manufacturer as approved by Architect.

2.2. MATERIALS

A. Sheet Metal Flashing/Trim (Roof):

1. Stainless Steel: AISI Type 302/304, ASTM A-167, 2D annealed finish, soft except where harder temper required for forming or performance; (22 gauge) except as otherwise indicated.
2. Aluminum: ASTM B209 (ASTM B209M); 20 gage (0.032 inch) thick; anodized finish of color as selected.
   a. Clear Anodized Finish: AAMA 611 AA-M12C22A41 Class I clear anodic coating not less than 0.7 mils thick.
   b. Color Anodized Finish: AAMA 611 AA-M12C22A42/44 Class I integrally or electrolytically colored anodic coating not less than 0.7 mils thick
3. Pre-Finished Aluminum: ASTM B209 (ASTM B209M)[<>]; 20 gage (0.032 inch) thick; plain finish shop pre-coated with modified silicone coating.
   a. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2604; multiple coat, thermally cured fluoropolymer finish system.
   b. Color: As selected by Architect from manufacturer's standard colors.

2.3. MISCELLANEOUS MATERIALS AND ACCESSORIES

A. Solder: For use with stainless steel, provide 60 - 40 tin/lead solder (ASTM D-32) with acid-chloride type flux, except use rosin flux over tinned surfaces.

B. Fasteners: Same metal as flashing/sheet metal or other noncorrosive metal as recommended by sheet manufacturer. Match finish of exposed heads with material being fastened.

C. Bituminous Coating: SSPC - Paint 12, solvent type bituminous mastic, nominally free of sulphur compounded for 15 mil dry film thickness per coat

D. Elastomeric Sealant: Type recommended by manufacturer of metal and fabricator of components being sealed; comply with ASTM C-920.

E. Adhesives: Type recommended by flashing sheet manufacturer for waterproof weather-resistant seaming and adhesive application of flashing sheet

F. Metal Accessories: Provide sheet metal clips, straps, anchoring devices and similar accessory units as required for installation of work, matching or compatible with material being installed, noncorrosive, size and gauge required for performance.

G. Plastic Roofing Cement: ASTM D4586/D4586M, Type I.

2.4. SLIP SHEET MATERIALS

A. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

1. Provide as needed for miscellaneous bond breakers and slip-sheeting only at metal copings.
2. Provide underlayment flashing membrane material according to membrane roofing manufacturer’s standard details as necessary to achieve the specified roof warranty.

2.5. GUTTERS AND DOWNSPOUTS

A. Gutters: Formed from same material as roof panels. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 10-foot-(3-m-)long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced per SMACNA’s recommendation based on gauge and stretch-out, fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match metal roof panels.

1. 1.Gutter Hangers: External gutter supports shall be 2-inch-(50-mm-) wide x ¼-inch-(6-mm-) thick formed aluminum, and shall be spaced at no greater than 36”(0.9m)on center. External supports shall be post-painted with a matching full-strength 70 percent PVDF finish and warranted by the panel manufacturer for same term as specified for material finishes.

2. 2. Gutter Straps: Internal gutter straps shall be 1-inch-(25-mm-) wide x 1/8-inch- (3-mm-) thick formed aluminum, and shall be spaced at no greater than 36”(0.9m) on center. Internal straps shall be post-painted with a matching full-strength 70 percent PVDF finish and warranted by the panel manufacturer for same term as specified for material finishes.

B. Downspouts: Formed from same material as roof panels. Fabricate in 10-foot- (3-m-) long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual". Finish downspouts to match gutters.

C. 1. Downspout Brackets: Where detailed, surface mounted downspout protection guards shall be fabricated from ¼-inch-(6-mm-) thick formed aluminum, and shall be post-painted with a matching full-strength 70 percent PVDF finish and warranted by the panel manufacturer for same term as specified for material finishes.

D. Color: Brown to match roof panels.

2.6. SOFFITS

A. Form soffits from 0.032 aluminum.

B. Profile: 12” w x ½” thick.

C. Full vented perforation pattern

D. Provide J-trim and all accessories, trims and anchors for a complete installation.

E. Color: Brown to match roof panels.

PART 3 - EXECUTION

3.1. EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

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

3.2. UNDERLAYMENT INSTALLATION

A. General: Install underlayment as indicated on Drawings.

B. Underlayment: Install underlayment for temporary anchorage to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).

3.3. INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
3. Space cleats not more than 12 inches (300 mm) apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
5. Install sealant tape where indicated.
6. Torch cutting of sheet metal flashing and trim is not permitted.

7. Retain subparagraph below if required to prevent galvanic corrosion between graphite and aluminum or aluminum-zinc alloy-coated steel. See the "Metal Considerations" Article in the Evaluations.
8. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.

1. Coat back side of uncoated aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.

D. Fastener Sizes: Use fasteners of sizes that will penetrate metal decking not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Seal joints as shown and as required for watertight construction.

1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).
2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

3.4. SHEET METAL FLASHINGS

A. General: Install sheet metal flashing and trim to comply with performance requirements and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

B. All base flashings and curbs shall be counterflashed with Stainless steel as specified above. The flashing cap shall lie against the base flashing and overlap the same not less than 4 "; end joints shall be clinch-locked and soldered; provide expansion joints in cap flashing for 100 lineal feet of run, maximum, using sliding lap 3" joints; lower edge of all cap flashings shall be stiffened with a 1/2" high folded hem. Metal at corners shall be continuous around the angle or shall be locked and soldered.

C. Flashing at Rising Wall: Install 26 gauge stainless steel through-wall as detailed. Outer edge shall be formed to receive and lock in cap flashing. Cap flashing shall be formed as shown and lock into receiver. Turn down cap flashing a minimum of 4". Lap end joints 3" or provide lock seams.

D. Coping Through-Wall Flashing: Install .26 gauge stainless steel combination through-wall under stone coping as detailed. Seal eye bolts and dowels with silicone sealant. Lap end joints 3" and seal with sealant or provide lock seams.

E. Flashing at Grade: Use 26 gauge stainless steel lap joints 3" and set in sealant. At locations where vertical distance exceeds 1'-4", the portion of flashing in cavity and in backup may be copper membrane. Lap membrane over Stainless steel a minimum of 4" and seal. Stainless steel shall terminate 1/2" behind exterior face of wall. Where membrane waterproofing occurs, turn stainless steel down over membrane a minimum of 8" and seal.

3.5. MEMBRANE FLASHINGS

A. For through-wall flashings shown at nonexposed areas, i.e., at juncture of face brick with concrete wall, beneath windowsills, overhead of windows and doors where shown. Include membrane flashings at all locations noted on drawings. Terminate flashing 1/2" behind exterior face of wall.

B. Install membrane flashings in accordance with manufacturer's directions using mastic to stick membranes to substrate insulation and board attached to masonry. Make side laps at least 3" wide, sealing folds with plastic cement where membranes are joined or pan-formed at ends. Use plastic cement where columns and pipes intercept the membrane for weathertight installation.

C. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches (100 mm) over base flashing. Install stainless-steel draw band and tighten.

D. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

E. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

3.6. ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.7. CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, remove unused materials and clean finished surfaces. Maintain in a clean condition during construction.

B. Clean off any discoloration of exposed metal. At soldered joints, remove all flux residues and neutralize acid. Rinse with clean water.

C. Flashing sheets shall not be broken or perforated in any manner when the roofing work has been completed. The formed metal shall not permit any accumulation of water on the surface; the end joints shall interlock and overlap at least 2", and the integral reglet shall allow insertion of cap flashings without bending after built-up base flashing has been completed.

D. Protection: Installer shall advise contractor of required procedures for protection of flashing and sheet metal work during construction to ensure that work will be without or deterioration at time of substantial completion.

END OF SECTION 07 60 00

SECTION 07 92 00

JOINT SEALANTS

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Urethane joint sealants.
3. Latex joint sealants.
4. Acoustical joint sealants.

B. Related Sections:

1. Division 04 Section "Unit Masonry" for masonry control and expansion joint fillers and gaskets.
2. Division 07 Section "Expansion Control" for building expansion joints.
3. Division 09 Section "Gypsum Board" for sealing perimeter joints.
4. Division 09 Section "Acoustical Panel Ceilings" for sealing edge moldings at perimeters with acoustical sealant.

1.3. PRECONSTRUCTION TESTING

A. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:

1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
2. Conduct field tests for each application indicated below:
    a. Each kind of sealant and joint substrate indicated.
3. Notify Architect seven days in advance of dates and times when test joints will be erected.
4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
    a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
        (1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.

6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.4. SUBMITTALS

A. Product Data: For each joint-sealant product indicated

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

E. Qualification Data: For qualified Installer.

F. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.

G. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.

H. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.

I. Preconstruction Field-Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.

J. Field-Adhesion Test Reports: For each sealant application tested.

K. Warranties: Sample of special warranties.

1.5. QUALITY CONTROL

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

C. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.

D. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.6. PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7. WARRANTY

A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1. MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D (EPA Method 24):

1. Architectural Sealants: 250 g/L.

2. Sealant Primers for Nonporous Substrates: 250 g/L.

3. Sealant Primers for Porous Substrates: 775 g/L.

C. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

D. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

E. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2. SILICONE JOINT SEALANTS

A. Mildew-Resistant, Single-Component, Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. BASF Building Systems; Omniplus.
   b. Dow Corning Corporation; 786 Mildew Resistant.
   c. GE Advanced Materials - Silicones; Sanitary SCS1700.
   d. May National Associates, Inc.; Bondaflex Sil 100 WF.
   e. Tremco Incorporated; Tremsil 200 Sanitary.

2.3. URETHANE JOINT SEALANTS

A. Multicomponent, Nonsag, Urethane Joint Sealant: ASTM C 920, Type M, Grade NS, Class 50, for Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Sika; Sikaflex 15LM
   b. Tremco Incorporated; Dymeric 240
   c. Pecora Corporation; Dynatrol II.
   d. Polymeric Systems, Inc.; PSI-270.

B. Multicomponent, Nonsag, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type M, Grade NS, Class 50, for Use T.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Tremco Incorporated; Dymeric 240 FC.
   b. Polymeric Systems, Inc.; PSI-270.

2.4. LATEX JOINT SEALANTS

A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. BASF Building Systems; Sonolac.
   b. Bostik, Inc.; Chem-Calk 600.
   c. May National Associates, Inc.; Bondaflex 600.
   d. Pecora Corporation; AC-20+.
   e. Schnee-Morehead, Inc.; SM 8200.
   f. Tremco Incorporated; Tremflex 834.

2.5. ACOUSTICAL JOINT SEALANTS

A. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Pecora Corporation; AC-20 FTR.
   b. USG Corporation; SHEETROCK Acoustical Sealant.

2.6. JOINT SEALANT BACKING

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

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.7. MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1. EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

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

3.2. PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
    a. Concrete.
    b. Masonry.
    c. Unglazed surfaces of ceramic tile.
3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
    a. Metal.
    b. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3. INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install 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, -sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.

3.4. FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:
   a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each kind of sealant and joint substrate.
   b. Perform 1 test for each 1000 feet (300 m) of joint length thereafter or 1 test per each floor per elevation.
2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
   a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
3. Inspect tested joints and report on the following:
   a. Whether sealants filled joint cavities and are free of voids.
   b. Whether sealant dimensions and configurations comply with specified requirements.
   c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5. CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6. PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7. JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.

1. Joint Locations:
    a. Isolation and contraction joints in cast-in-place concrete slabs.
    b. Tile control and expansion joints.
    c. Other joints as indicated.
2. Urethane Joint Sealant: Multicomponent, nonsag, traffic grade, Class 50.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

B. Joint-Sealant Application: Exterior and interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:
    a. Construction joints in cast-in-place concrete.
    b. Joints between plant-precast architectural concrete units.
    c. Control and expansion joints in unit masonry.
    d. Joints between different materials listed above.
    e. Perimeter joints between materials listed above and frames of doors, windows, and louvers.
    f. Other joints as indicated.
2. Urethane Joint Sealant: Multicomponent, nonsag,, Class 50.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
4. Silicone based sealant may also be used to at exterior locations at non-exposed conditions or if colored type may be considered for use at certain exposed exterior envelope conditions.

C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.

1. Joint Locations:
    a. Isolation joints in cast-in-place concrete slabs.
    b. Other joints as indicated.
2. Urethane Joint Sealant: Multicomponent, nonsag, traffic grade, Class 50.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:
    a. Control and expansion joints on exposed interior surfaces of exterior walls.
    b. Perimeter joints of exterior openings where indicated.
    c. Vertical joints on exposed surfaces of interior unit masonry walls and partitions.
    d. Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances.
    e. Other joints as indicated.
2. Joint Sealant: Latex acrylic based.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
4. Silicone based sealant may also be used at certain interior locations as approved by the Architect. Clear type may used where visual conditions allow the installation to be inconspicuous; verify condition of use with the Architect.

E. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Sealant Location:
    a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
    b. Tile control and expansion joints where indicated.
    c. Other joints as indicated.
2. Joint Sealant: Single component, nonsag, mildew resistant, acid curing.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

F. Joint-Sealant Application: Interior acoustical joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Location:
    a. Acoustical joints where indicated.
    b. Other joints as indicated.
2. Joint Sealant: Acoustical.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

END OF SECTION 07 92 00

SECTION 08 11 13

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. SUMMARY

A. Section Includes:

1. Standard hollow metal doors and frames.

B. Related Sections

1. Section 07 60 00 – Flashings and Sheet Metal
2. Section 07 92 00 - Joint Sealants
3. Section 08 71 00 - Door Hardware

1.3. SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, hardware reinforcements, profiles, anchors, fire-resistance rating, and finishes.

B. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the steel door and frame supplier in order to prepare the doors and frames to receive the finish hardware items.

C. Shop Drawings: Include the following:

1. Elevations of each door design.
2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of anchorages, joints, field splices, and connections.
6. Details of accessories.
7. Details of moldings, removable stops, and glazing.
8. Details of conduit and preparations for power, signal, and control systems.

D. Samples for Verification:

1. Samples are only required by request of the architect and for manufactures that are not current members of the Steel Door Institute.

1.4. REFERENCE STANDARDS

A. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frames Anchors and Hardware Reinforcing.

B. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.

C. ANSI/SDI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.

D. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.

E. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames.

F. ASTM A653/ASTM A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

G. ASTM A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.

H. ANSI/BHMA A156.15 - Hardware Preparation in Steel Doors and Frames.

I. ANSI/SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.

J. NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.

K. NFPA 105: Standard for the Installation of Smoke Door Assemblies.

L. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.

M. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.

N. UL 10C - Positive Pressure Fire Tests of Door Assemblies.

O. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

P. Unified Facilities Criteria (UFC) 4-010-01: DoD Minimum Antiterrorism Standards for Buildings

Q. Unified Facilities Criteria (UFC) 4-020-01: DoD Security Engineering Facilities Planning Manual

1.5. QUALITY CONTROL

A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer.

B. Quality Standard: In addition to requirements specified, comply with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames".

C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 (neutral pressure at 40” above sill) or UL 10C.

1. Oversize Fire-Rated Door Assemblies Construction: For units exceeding sizes of tested assemblies, attach construction label certifying doors are built to standard construction requirements for tested and labeled fire rated door assemblies except for size.
2. Temperature-Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.

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 installing hollow metal doors and frames and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

1.6. DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project site storage. Do not use non-vented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.

1. Provide minimum 1/4-inch space between each stacked door to permit air circulation. Door and frames to be stacked in a vertical upright position.

1.7. PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.8. COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.9. WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide hollow metal door and frame products by one of the following:

1. Assa Abloy Curries
2. Republic Doors.
3. Steelcraft.

2.2. MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

C. Frame Anchors: ASTM A 653/A 653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

2.3. STANDARD HOLLOW METAL DOORS

A. General: Provide 1-3/4 inch doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.

B. Interior Doors: Face sheets fabricated of commercial quality cold rolled steel that complies with ASTM A 1008/A 1008M. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Design: Flush panel.
2. Core Construction: Manufacturer's standard kraft-paper honeycomb, or one-piece polystyrene core, securely bonded to both faces.
    a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
3. Level/Model: Level 2 and Physical Performance Level B (Heavy Duty), Minimum 18 gauge (0.042-inch - 1.0-mm) thick steel, Model 2.
4. Vertical Edges: Vertical edges to have the face sheets spot welded and filled full height with an epoxy filler. Welds are to be ground, filled and dressed smooth. Beveled Lock Edge, 1/8 inch in 2 inches (3 mm in 50 mm).
5. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet.
6. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
7. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

C. Manufacturers Basis of Design:

1. Assa Abloy Curries Company 707 Series.
2. Assa Abloy Curries Company Steel-Stiffened: 747 Series.

2.4. STANDARD HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

B. Interior Frames: Fabricated from cold-rolled steel sheet that complies with ASTM A 1008/A 1008M.

1. Fabricate frames with mitered or coped corners.
2. Fabricate frames, with the exception of slip-on drywall types, with "closed and tight" miter seams continuously welded on face, finished smooth with no visible seam unless otherwise indicated.
3. Frames for Level 2 Steel Doors: Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.
4. Frames for Level 3 Steel Doors (up to 48 inches in width): Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.]

5. Frames for Level 3 Steel Doors (48 inches and up in width): Minimum 14 gauge (0.067-inch -1.7-mm) thick steel sheet.]
6. Frames for Wood Doors: Minimum 16 gauge (0.053-inch-1.3-mm-) thick steel sheet.
7. Frames for Borrowed Lights: Minimum 16 gauge (0.053-inch-1.3-mm-) thick steel sheet.
8. Manufacturers Basis of Design:
    a. Curries Company M/G Series (Masonry Profile).

C. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.5. FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed from A60 metallic coated material, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
2. Stud Wall Type: Designed to engage stud and not less than 0.042 inch thick.

B. Floor Anchors: Floor anchors to be provided at each jamb, formed from A60 metallic coated material, not less than 0.042 inches thick.

C. Mortar Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.6. HOLLOW METAL PANELS

A. Provide hollow metal panels of same materials, construction, and finish as specified for adjoining hollow metal work.

2.7. ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Grout Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.8. FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.

C. Hollow Metal Doors:

1. Exterior Doors: Provide optional weep-hole openings in bottom of exterior doors to permit moisture to escape where specified.
2. Glazed Lites: Factory cut openings in doors with applied trim or kits to fit. Factory install glazing where indicated.

3. Astragals: Provide overlapping astragals as noted in door hardware sets in Division 08 Section "Door Hardware" on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.
4. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".

D. Hollow Metal Frames:

1. Shipping Limitations: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
2. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
    a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.
3. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
4. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.
5. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
6. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.
7. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.
8. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
9. Jamb Anchors: Provide number and spacing of anchors as follows:
    a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
        (1) Two anchors per jamb up to 60 inches high.
        (2) Three anchors per jamb from 60 to 90 inches high.
        (3) Four anchors per jamb from 90 to 120 inches high.
        (4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
    b. Stud Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
        (1) Three anchors per jamb up to 60 inches high.
        (2) Four anchors per jamb from 60 to 90 inches high.
        (3) Five anchors per jamb from 90 to 96 inches high.
        (4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.

(5) Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.

10. Door Silencers: Except on weatherstripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware".

E. Hardware Preparation: Factory prepare hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."

1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
2. Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

2.9. STEEL FINISHES

A. Prime Finishes: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead and chromate free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; and compatible with substrate and field-applied coatings.

PART 3 - EXECUTION

3.1. EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. General Contractor to verify the accuracy of dimensions given to the steel door and frame manufacturer for all rough openings and existing openings where frames are being removed and replaced or scheduled to remain.

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

3.2. PREPARATION

A. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness.

C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."

D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

3.3. INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11 and NFPA 80 at fire rated openings.

1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.
2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar.
4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:
    a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
    b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
    c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
    d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

D. Field Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.

3.4. ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow metal work immediately after installation.

C. Prime-Coat and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.

END OF SECTION 08 11 13

SECTION 08 17 43

PULTRUDED DOOR AND FRAMES

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. SECTION INCLUDES

A. Fiberglass reinforced polyester (FRP) flush doors with FRP frames.

1.3. RELATED SECTIONS

A. Section 08 71 00 - Door Hardware

B. Section 05 40 00 – Cold Formed Metal Framing

1.4. REFERENCES

A. AAMA 920-11 – Specification for Operating Cycle Performance of Side-Hinged Exterior Door Systems.

B. AAMA 1304 - Voluntary Specification for Forced-Entry Resistance of Side-Hinged Door Systems.

C. ASTM C 1363-97 – Thermal Test Method for the Thermal Performance of Building Assemblies.

D. ASTM D 1622 - Standard Test Method for Apparent Density of Rigid Cellular Plastics

E. ASTM D 6670-01 - Standard Practice for Full-Scale Chamber Determination of Volatile Organic Emissions from Indoor Materials/Products.

F. ASTM E 283-04 – Test Method for Determining Rate of Airflow Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen.

G. ASTM E 330-02 – Test Method for Structural Performance of Exterior Windows, Curtain Walls, Doors by Uniform Static Air Pressure Difference.

H. ASTM E 331-00 – Test Method for Water Penetration of Exterior Windows, Curtain Walls and Doors, and Curtain Walls by Uniform Static Air Pressure Difference.

I. ASTM E 1886-05 – Test Method for Performance of Exterior Windows, Curtain Wall, Doors and Storm Shutters Impacted by Missile(s) and Exposed to Cyclic Pressure Differential.

1.5. PERFORMANCE REQUIREMENTS

A. General: Provide door assemblies that have been designed and fabricated to comply with specified performance requirements, as demonstrated by testing manufacturer's corresponding standard systems.

B. Thermal Performance: Per ASTM C 1363-97, R-value 7.42.

C. Air Infiltration: For a single door 3’-0” x 7’-0”, test specimen shall be tested in accordance with ASTM E 283 at pressure differential of 6.24 psf. Door shall not exceed 0.09 cfm/ft^2.

D. Water Penetration: For a single door 3’-0” x 7’-0”, test specimen shall be tested in accordance with ASTM E 331. Door shall not have water leakage.

E. Uniform Load Structural: For a single door 3’-0” x 7’-0”, test specimen shall be tested in accordance with ASTM E 330: Plus or minus 270 psf.

F. Forced Entry Resistance, per AAMA 1304, Pass with No Entry.

G. Air Pressure Cycling, Doors and Frames, ASTM E 1886, Design Pressure Plus or Minus 100 psf, Pass with no rips, tears, or penetrations.

H. Cycle Test, AAMA 920-11, 2,000,000 Cycles.

I. Screw Pullout, ASTM D 1761-06, Minimum 924 pounds.

1.6. SUBMITTALS

A. Comply with Division 1.

B. Product Data: Submit manufacturer's product data, including description of materials, components, fabrication, finishes, and installation.

C. Shop Drawings: Submit manufacturer's shop drawings, including elevations, sections, and details, indicating dimensions, tolerances, materials, fabrication, doors, panels, framing, and finish.

D. Samples:

1. Door: Submit manufacturer's sample of door showing face sheets, core, framing, and finish.
2. Color: Submit manufacturer's samples of standard colors of doors and frames.

E. Test Reports: Submit test reports from qualified independent testing agency indicating doors comply with specified performance requirements.

F. Maintenance Manual: Submit manufacturer's maintenance and cleaning instructions for doors, including maintenance and operating instructions for hardware.

G. Warranty: Submit manufacturer's standard warranty.

1.7. QUALITY CONTROL

A. Manufacturer's Qualifications:

1. Continuously engaged in manufacturing of doors of similar type to that specified, with a minimum of 25 years successful experience.
2. Door and frame components from same manufacturer.
3. Evidence of a compliant documented quality management system.

1.8. DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying opening door mark and manufacturer.

B. Storage: Store materials in clean, dry area indoors in accordance with manufacturer's instructions.

C. Handling: Protect materials and finish from damage during handling and installation.

1.9. WARRANTY

A. Warrant doors, frames, and factory hardware against failure in materials and workmanship, including excessive deflection, faulty operation, defects in hardware installation, and deterioration of finish or construction in excess of normal weathering.

B. Warranty Period: Ten years starting on date of shipment. In addition, a limited lifetime (while the door is in its specified application in its original installation) warranty covering: failure due to corrosion

PART 2 - PRODUCTS

2.1. MANUFACTURER

A. Basis of Design Manufacturer: Special-Lite, Inc., PO Box 6, Decatur, Michigan 49045. Toll Free (800) 821-6531. Phone (269) 423-7068. Fax (800) 423-7610. Web Site www.special-lite.com. E-Mail info@special-lite.com.

1. Other acceptable manufacturers include Stromberg, Harvey or other manufacturer as approved by Architect.

2.2. FRP FLUSH DOORS

A. Model: AF-150 Pultruded FRP Door.

B. Construction:

1. Door Thickness: 1-3/4 inches.
2. Construction: Doors shall be FRP, pultruded as one monolithic panel, with integral stiles.
3. Reinforcement: Solid FRP shapes to be chemically welded at factory. All structural members shall utilize a chemically resistant UV stabilized resin system.
4. Stile Edge: Seamless 9/16” thick solid FRP.
5. Top Rail: 6” pultruded tube profile designed to fit flush and be chemically welded inside the door.
6. Bottom Rail: Pultruded FRP inverted U channel designed to fit flush and be chemically welded inside the door, allowing doors to be field trimmed. Closed bottom rail to be supplied as an option.

C. Face Sheet:

1. Material: Pultruded FRP, 0.125-inch thickness.
2. Texture: Smooth.
3. Fiberglass Content: Minimum 47% by weight.
4. Color: As selected by architect from manufacturer’s standard range.

D. Core:

1. Material: Polyurethane foam.
2. Density: Minimum of 6 pounds per cubic foot.
3. Per ASTM E 84 flame spread and smoke developed: Class B.

E. Hardware:

1. Pre-machine doors in accordance with templates from specified hardware manufacturers and hardware schedule.

2.3. MATERIALS

A. Components: Door and frame components from same manufacturer.

B. Fasteners:

1. Material: Aluminum, 18-8 stainless steel, or other noncorrosive metal.
2. Compatibility: Compatible with items to be fastened.

2.4. FABRICATION

A. Sizes and Profiles: Required sizes for door and frame units, and profile requirements shall be as indicated on the Drawings.

B. Coordination of Fabrication: Field measure before fabrication and show recorded measurements on shop drawings.

C. Assembly:

1. Complete cutting, fitting, forming, drilling, and chemically welding of FRP before assembly.

D. Fit:

1. Maintain continuity of line and accurate relation of planes and angles.
2. Secure attachments and support at mechanical joints with hairline fit at contacting members.

2.5. FRP FRAMING SYSTEMS

A. Framing:

1. Materials: ¼" thick solid pultruded FRP profiles having no corrosive components or reinforcement.
2. Width: 2" face.
3. Depth: As indicated on drawings. Coordinate throat size with adjacent wall assembly.
4. Assembly: Knock down (KD) for field assembly.
5. Door Stop: 5/8" x 2 ¼".
6. Corner Construction: Mitered with 4" x 4" x 3/8" pultruded FRP angle reinforcement with interlocking pultruded FRP brackets.
7. Reinforcing: ¼" pultruded FRP chemically welded at all hinge, strike and closer locations.
8. Fasteners for reinforcing: 18-8 Stainless Steel.

2.6. FINISH

A. Finish For Doors and Frames: Primer with a finished color coat.

1. Painted Finish: Two-part aliphatic polyurethane, low VOC, Industrial Coating.
2. Thickness: 5 mils
3. Sheen: Gloss
4. Impact Resistance per ASTM D 2794: 140 in lbs.

PART 3 - EXECUTION

3.1. EXAMINATION

A. Examine areas to receive doors. Notify Architect of conditions that would adversely affect installation or subsequent use. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2. PREPARATION

A. Ensure openings to receive frames are plumb, level, square, and in tolerance.

3.3. INSTALLATION

A. Install doors in accordance with manufacturer's instructions.

B. Install doors plumb, level, square, true to line, and without warp or rack.

C. Anchor frames securely in place.

D. Install exterior doors to be weathertight in closed position.

E. Repair minor damages to finish in accordance with manufacturer's instructions and as approved by Architect.

F. Remove and replace damaged components that cannot be successfully repaired as determined by Architect.

3.4. FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Manufacturer's representative shall provide technical assistance and guidance for installation of doors.

3.5. ADJUSTING

A. Adjust doors, hinges, and locksets for smooth operation without binding.

3.6. CLEANING

A. Clean doors promptly after installation in accordance with manufacturer's instructions using a mild detergent and water.

3.7. PROTECTION

A. Protect installed doors to ensure that, except for normal weathering, doors will be without damage or deterioration at time of substantial completion.

END OF SECTION 08 17 43

SECTION 08 31 13

ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. SUMMARY

A. Section Includes:

1. Access doors and frames for walls and ceilings.

1.3. ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, fire ratings, materials, individual components and profiles, and finishes.

B. Shop Drawings:

1. Include plans, elevations, sections, details, and attachments to other work.
2. Detail fabrication and installation of access doors and frames for each type of substrate.

C. Product Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

PART 2 - PRODUCTS

2.1. ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Babcock-Davis.
2. J. L. Industries, Inc.
3. Larsen's Manufacturing Company.

B. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.

C. Flush Access Doors with Exposed Flanges to be provided in gypsum board ceilings and walls.

1. Basis-of-Design Product: Non-rated locations, Model BNT as manufactured by Babcock Davis, Brooklyn Park, MN.

2. Assembly Description: Fabricate door to fit flush to frame.
3. Locations: Flush installation at vertical or horizontal surfaces.
4. Door Size: As required.
5. Steel Sheet for Door: 14 gauge
    a. Finish: Grey baked-on factory powder coated finish where not exposed to view.
    b. Provide primed finish for field painting where exposed to view.
6. Frame Material: Steel Sheet 14 gauge
7. Hinges: Concealed continuous piano hinge.
8. Hardware: Flush key-operated cam lock.
9. Options: Masonry anchors as required.

D. Flush Access Doors with concealed Flanges are to be provided in walls finished with tile or other wall covering.

1. Provide this type if special condition occurs in restrooms, showers, locker rooms or other areas with wall finishes other than paint.

2.2. MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.

C. Frame Anchors: Same type as door face.

D. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.3. FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.

1. For concealed flanges with drywall bead, provide edge trim for gypsum board securely attached to perimeter of frames.
2. For concealed flanges with plaster bead for full-bed plaster applications, provide zinc-coated expanded metal lath and exposed casing bead welded to perimeter of frames.
3. Provide mounting holes in frames for attachment of units to metal or wood framing.
4. Provide mounting holes in frame for attachment of masonry anchors.

D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.

1. For cylinder locks, furnish two keys per lock and key all locks alike.

2. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.

2.4. FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Steel and Metallic-Coated-Steel Finishes:

1. Factory Prime: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
2. Factory Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry-film thickness of 1 mil (0.025 mm) for topcoat.

PART 3 - EXECUTION

3.1. EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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

3.2. INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.3. ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 08 31 13

SECTION 08 71 00
DOOR HARDWARE

1.1 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:
   1. Hardware for swinging Aluminum and Hollow Metal Door Openings.

B. Related Sections:
   1. Section 01 25 13 – Product Substitution Procedures
   2. Section 08 11 13 – Hollow Metal Doors and Frames
   3. Section 08 41 13 – Aluminum-Framed Entrances and Storefronts
   4. Section 26 05 19 – Low Voltage Electrical Power Conductors and Cables

1.3 REFERENCES

A. Use the following references to properly detail, schedule, furnish and install finish hardware items.
   1. NFPA 80 – Standard for Fire Doors and Other Opening Protectives (2007)
   2. DHI Installation Guide for Doors and Hardware (1984)
   3. DHI Sequence and Format for the Hardware Schedule (1996)
   4. ANSI/BHMA A156.4 – Door Controls – Closers (2013)
   5. ANSI/BHMA A156.2 – Bored and Preassembled Locks and Latches (2011)
   6. ANSI/BHMA A156.18 – Materials and Finishes (2012)

1.4 SUBMITTALS

A. Schedule:
   1. Provide submittals in accordance with 01 33 00 – Submittal Procedures.
   2. Provide hardware schedule in vertical format on 8-1/2-inch by 11-inch paper for electronic format. Conform to DHI publication Sequence and Format for Hardware Schedule using Architect's door numbers and hardware set numbers.
   3. Provide elevation drawings for openings with electrical hardware and access control devices with each hardware schedule. Include illustration of opening, operational description, electrified hardware components, legend, approximate mounting location and size of enclosures, size and quantity of conductors, facility name and date.

B. Product Data: Provide one set of manufacturer's catalog and technical data for each hardware item used, highlighting design, function, fasteners, accessories, and options to facilitate review with each hardware schedule submitted.

C. Templates: Provide two sets of manufacturer's templating information for mortised and template hardware upon receipt of approved hardware schedule to the door and frame supplier(s). Include requirements for internal reinforcements required for surface mounted hardware.

D. Wiring Diagrams:
    1. Three sets point-to-point diagrams specially developed for each opening that requires electrical hardware, with hardware delivery to jobsite. Reference elevation drawings submitted with hardware schedule using Architect's opening numbers.

    2. Three sets riser diagrams for openings requiring power supplies or access control. Include placement of power supplies, distance of wire runs from power supply, cable quantity and number and gauges of wires.

E. Keying Schedule: Arrange meeting with Owner, Architect and finish hardware supplier to determine keying requirements immediately upon receipt of finish hardware schedule.

1.5 CLOSEOUT SUBMITTALS

A. Furnish operations and maintenance manual is accordance with Section 01 78 28 – Operations and Maintenance Data and as follows:

    1. Furnish one copy of manual at date of Substantial Completion in a 2-1/2-inch thick binder labeled with project information, date and name and contact information for the hardware supplier.
    2. Include in manual:
        a. Copy of approved hardware schedule, including door numbers and locations. Highlight fire rated door to aid in annual fire door inspection.
        b. Copy of approved keying schedule.
        c. Catalog data for each product.
        d. As-installed "wiring diagrams" for each opening connected to power.
        e. Parts list for locksets, exit devices, door closers, and auto door operators.
        f. Installation templates and instructions.
        g. Warranty information.
        h. Name, address, and phone number of local representatives for each manufacturer.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Materials:

    1. Screws and Fasteners: Fifty of each screw and fastener required for general maintenance of hinges, locks, closers, exit devices, and sealing systems.
    2. Deliver to Owner remaining finish hardware fasteners and special installation tools upon completion of Project.

1.7 QUALITY CONTROL

A. Supplier:
    1. Furnish hardware from recognized supplier who has warehousing facility within 100 miles of project location, and who has actively supplied hardware for similar projects in the vicinity for a minimum of five years.
    2. Supplier shall employ an Architectural Hardware Consultant (AHC), as certified by Door and Hardware Institute, on staff full time to administer and supervise project.

B. Installer: Install hardware using installers who have actively installed commercial door hardware for a minimum of five years, and are familiar with hardware installation of type required on this Project.

C. Pre-Installation Meeting:
   1. Prior to installation of hardware, arrange for manufacturer's representatives of locksets, door closers, and exit devices to hold a jobsite meeting to instruct the installing personnel on the proper installation of their products.
   2. Send a letter of compliance, indicating when this meeting was held, and who was in attendance, to the Architect and Owner.

D. Fire Rated Door Openings:
   1. Comply with NFPA 80.
   2. Furnish nationally recognized testing agency label or stamp on hardware for labeled openings.
   3. Only labeled locks or latches or fire exit hardware can be used on fire rated openings.
   4. Where UL requirements conflict with Drawings or Specifications, furnish hardware conforming to the UL requirements.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Delivery:
   1. Jointly check in hardware, upon delivery to jobsite, against approved hardware schedule with hardware supplier. Record shortage or damage and replace or repair as necessary.
   2. Deliver hardware to be installed during fabrication of doors and frames, to manufacturer.

B. Storage:
   1. Store hardware in a secure, dry, temperature controlled room on shelving to protect against loss, theft and damage.
   2. Store items too long for shelving on pallet, off the floor.

C. Marking and Packaging:
   1. Deliver hardware to jobsite in manufacturer's original packaging marked to correspond with approved hardware schedule with Architect's door numbers and hardware sets.
   2. Mark all locksets, exit devices, cylinders, auxiliary hardware and key switches with keyset symbol.
   3. Replace any wet or damaged packaging with new.

1.9 WARRANTY

A. Furnish warranties in accordance with Section 01 78 36 – Warranties. Extended or limited warranties shall be as follows:
   1. Furnish minimum ten year factory warranty on door closers, against defects in material and workmanship, from date of substantial completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. The following manufacturers' were used in the hardware sets.

1.	Hinges	Stanley	ST
2.	Continuous Hinges	Stanley	ST
3.	Locks and Latchsets	Best	BE
4.	Cylinders and Cores	Best	BE
5.	Surface Closers	Stanley	ST
6.	Exit Devices	Precision	PR
7.	Overhead Stop/Holders	ABH	AB
8.	Flushbolts	Trimco	TR
9.	Protection Plates	Trimco	TR
10.	Wall/Floor Stops	Trimco	TR
11.	Thresholds and Gasketing	NGP	NA
12.	Electric Strikes	Trine	TRI
13.	Silencers	Trimco	TR

B. Submit requests for substitution in accordance with Section 01 25 13 Product Substitution Procedures and as follows:
   1. Provide catalog data with product information highlighted or bubbled to facilitate review. Product must meet or exceed level or design intended and/or function established by specified products.
      a. Exit devices to be independently tested to minimum 10,000,000 cycles.

2.2 MATERIALS

A. Screws and Fasteners:
   1. Provide manufacturer's recommended fasteners of proper type, material and finish.
   2. Provide self-tapping screws for sweeps and stop applied weatherstripping.
   3. Utilize through-bolts for the attachment of door closers and exit devices on non-reinforced doors only. Finish: match door face.
   4. Exposed screw heads: phillips type.

B. Hinges:
   1. Type:
      a. Five-knuckle, full mortise, ball bearing.
      b. Furnish heavy weight hinges on heavy doors and doors expected to have high frequency use.
   2. Quantity:
      a. One pair of hinges for all doors up to 5 feet high. Furnish one additional hinge for every 2'-6" in height or fraction thereof.
      b. Four hinges at dutch doors up to 7'-6" in height.
   3. Size:
      a. For 1-3/4-inch thick doors up to 3 feet wide: 4 ½-inches high
      b. For 1-3/4-inch thick doors over 3 feet wide: 5-inches high
      c. For all doors over 1-3/4-inches thick: 5-inches high
      d. Size in width shall minimally clear door trim.
   4. Application:
      a. NRP (non-removable pin) at exterior doors and reverse bevel doors with locking hardware.

b. Electric hinges: have sufficient number of concealed wires to accommodate electrical function of hardware. Furnish junction box and mortar shield.

5. Acceptable manufacturers and types:

Stanley	Hager	Bommer
FBB179	BB1279	BB5000
FBB168	BB1168	BB5004
FBB191	BB1191	BB5002
FBB199	BB1199	BB5006

C. Continuous Hinges:

1. Configuration appropriate for type, inset, and thickness of door. Coordinate with door manufacturer.
2. Meet UL fire label listing requirements at UL rated openings. Include fire pins as required by manufacturer.
3. Acceptable manufacturers and types:

Door Type	Stanley	ABH	Select
Aluminum	661HD	A110HD	SL11HD
Hollow Metal	662HD	A240HD	SL24HD

D. Flushbolts:

1. Manual Flushbolts: Two for inactive leaf of locked pairs of door.
2. Automatic Flushbolts: One pair at fire rated doors, and occupied rooms required for egress.
3. Acceptable manufacturers and types:

Bolt/Door Type	ABH	Trimco	Burns
Manual Metal	1855S	3917	590
Manual Wood	1857S	3913	591
Automatic Metal	1860P	3810	7842
Automatic Wood	1862P	3815	7942
Semi-Auto Metal	1863P	3820 x 3810	7845
Semi-Auto Wood	1864P	3825 x 3815	7945

E. Locksets:

1. Cylindrical Locks:
    a. Conform to ANSI/BHMA A156.2, Series 4000 Operational Grade 1.
    b. All locks shall be furnished with removable core cylinders as manufactured by Best Lock Corporation, Falcon Lock Co., or Arrow Lock Corp., and shall be a factory recorded continuation or extension of an existing keying system previously furnished by these manufacturers for this institution.
    c. Latchbolt with appropriate throw for fire rated doors and pairs of doors in accordance with manufacturers listing.
    d. Lock functions as specified in hardware schedule.
    e. Lever design: 15D
    f. Backset: 2-3/4-inch
    g. Strike single door: ANSI 4-7/8-inch with proper lip length to minimally clear trim.
    h. Strike pair of doors: flat lip strike sized to fit flush with face of door.
    i. Furnish wrought strike box.
    j. Acceptable manufacturers and types:

Best	Dorma	Schlage ND
9K Series	C800 Series	T Series

2. Cylinders:
    a. Provide mortise and rim cylinders and cores from Best Access Systems for all locksets, exit devices, cylinder dogging, key switches and auxiliary hardware.
    b. Appropriate cam and blocking rings for proper installation.
    c. Cylinders shall be furnished complete with collars, construction cores, 7-pin interchangeable cores, and two keys per cylinder. Cylinders shall be of correct type and length, fitted with correct cam or bar for operation of lock, and furnished with back plates and screws where required.

F. Keys & Keying
1. Cylinders: 7-pin, interchangeable core and keyed into an existing BEST PEAKS factory registered Masterkey System.
2. The Key Coding records shall be sent by Registered Mail per PennDOTS's instructions. These records shall go directly from the Manufacturer to the Institution and shall not pass through the hands of the Hardware Distributor.
3. Construction cores shall be supplied to the General Contractor during the period of construction. These construction cores shall be returned to the Manufacturer after the permanent master keyed cores are installed.
4. Cores are to be Grand Master Keyed, Master Keyed, Keyed alike in Groups, and/or Keyed individually, as approved by PennDOT. A Keying Schedule showing each door location, Manufacturer's lock number, Manufacturer's cylinder type number, finish, length, cam or bar type, and keying detail, shall be prepared by the Cylinder Manufacturer's Representative for the Hardware Supplier, and submitted to PennDOT for approval.
5. Furnish six (6) Master Keys for each group. Furnish six (6) Grand Master keys and one (1) Control Key, if a new Grand Master Key System is established. The above keys shall be included with the shipment of permanent cores.

G. Exit Devices:
1. UL-listed for fire at fire door assemblies, and UL listed for panic at non-rated door assemblies.
2. Size exit devices to proper door width and height.
3. Stainless Steel deadlocking ¾-inch throw latch bolt.
4. LBR (less bottom rod) where scheduled to eliminate use of floor mounted strikes.
5. Provide fire pins where LBR is schedule on fire rated doors.
6. Cylinders for exit devices with cylinder dogging or locking trim.
7. Provide Motorized Latch Retraction (MLR) where scheduled. Include power transfer and power supply.
8. Provide request to exit (TS Touch Sense switch) for security monitoring where scheduled.
9. Strike: as recommended by manufacturer.
10. Lever design: To match lockset trim.
11. Acceptable manufacturers and types:

Precision	Von Duprin	Dorma
Apex 2000 Series	98 Series	9000 Series

H. Surface Door Closers:

1. Conform to ANSI/BHMA A156.4 Grade 1.
2. Heavy duty cast iron or aluminum body closers.
3. Furnish manufacturers recommended size, arms and configuration for door and frame application required.
4. Furnish brackets, spacers, support shoes, and plates for complete and proper installation.
5. DA (delayed-action) at toilet room doors and as scheduled.
6. Acceptable manufacturers and types:

Best	LCN	Dorma
HD8000 Series	4040XP Series	8900 Series

I. Protection Plates:
1. Where bottom rail allows, furnish 10-inch high kick plates and 10-inch high mop plates.
2. Material: 0.050-inch thick stainless steel plates with four beveled edges.
3. Countersink screw heads.
4. Width: 2-inch less door width on stop (push) side and 1-inch less door width on face (pull) side.
5. Both sides of doors.
6. Acceptable manufacturer and types:

Trimco	Burns	Rockwood
K0050	KP50	K1050

J. Door Stops:
1. Provide convex, cast, wall stops unless turn piece or push button on lockset handle makes contact with stop. Where contact is made provide concave wall stop.
2. Provide wedge type stop for doors with push/pulls.
3. Where wall stops cannot be used, provide universal dome type floor stops of the proper height.
4. Furnish fastener suitable for wall condition.
5. Acceptable manufacturers and types:

Type	Trimco	Burns	Rockwood
Wall-Convex	1270CX	560	400
Wall-Concave	1270CV	565	403
Floor	1211	521	441H

K. Thresholds and Gasketing:
1. Thresholds:
    a. Returned closed ends at openings where threshold extends beyond frame face.
    b. Acceptable manufacturers and types:

Type	Pemko	National Guard	Reese
Saddle	171	425	S205A
Saddle	271	513	S405A
Panic Threshold	2005	896 N	S483

2. Gasketing:
    a. Rigid jamb weatherstip with replaceable silicone insert.
    b. Include self-adhesive two-sided tape in addition to manufacturer's standard fastener.
    c. Meeting-stile gasketing required at exterior pairs of doors and doors in smoke partitions.

d. Flexible adhesive fire/smoke gasketing at “S” labeled openings.
e. Acceptable manufacturers and types:

Type	Pemko	National Guard	Reese
Rigid	290ASSTOP	700 ES	657C
Flexible	PK55	2525	638CH

L. Silencers:
1. Grey rubber silencers with injector tool.
2. Three silencers at single doors and two silencers at pairs without door seal.
3. Acceptable manufacturers and types:

Trimco	Rockwood	Burns
1229A	608	500

2.3 FINISHES

A. Conform to ANSI/BHMA A156.18.

1.	Exterior Hinges	630	Satin Stainless Steel
2.	Interior Hinges	626	Satin Chrome
3.	Locks and Latches	626	Satin Chrome
4.	Exit Devices	630	Satin Stainless Steel
5.	Door Closers	689	Spray Painted Aluminum
6.	Push/Pulls	630	Satin Stainless Steel
7.	Protection Plates	630	Satin Stainless Steel
8.	Stops and Holders	630	Satin Stainless Steel
9.	Thresholds/Gasket	AL	Anodized Mil Finished Aluminum

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify doors and frames are plumb, square, level and true and free from defects that would prevent proper installation of finish hardware.

B. Verify frames are securely anchored to floor.

C. Verify power is run to doors requiring electrified hardware.

D. Wash down masonry walls and complete painting and staining of doors and frames prior to installation of hardware.

E. Verify fire rated openings have fire rating labels attached.

F. Complete finish flooring at doorways.

G. Correct conditions that inhibit a proper installation before continuing with work.

3.2 INSTALLATION

A. Install hardware in compliance with the DHI publication, Installation Guide for Doors and Hardware.

B. Drill and countersink items not factory prepared for fasteners.

C. Mount closers on room-side of corridor doors, inside of exterior doors, and stair-side of stairway doors. Use necessary arms, brackets, spacers, and plates to accommodate auxiliary hardware and special applications.

D. Install fire door assemblies to maintain clearances at door edge to frame and meeting edge of pairs of doors in compliance with NFPA 80, providing 1/8-inch clearance at the hinge edge, lock edge, head and between pairs. Provide maximum 3/4-inch undercut at door bottom. Where panic thresholds are used, undercut door to allow 1/8-inch clearance between door and threshold.

E. Trim, cut, and notch thresholds and saddles neatly to minimally fit the profile of the door frame. Set thresholds in bed of mastic sealant, forming tight seal between threshold and surface to which set.

F. Use only fasteners furnished by manufacturer for installation as recommended by manufacturer.

G. Install blocking material for all wall mounted door stops at height appropriate to contact door trim.

H. Install weather-strip prior to installation of door closers and exit devices. Do not cut or notch weather-strip.

I. Locate electric hinges at second hinge from bottom of frame.

J. Termination of wiring: Ensure wiring is in place and is connected for proper operation of hardware.

3.3 FIELD QUALITY CONTROL

A. Verify doors open and close smoothly without rubbing or catching and have positive latching where scheduled. Verify fire rated doors are installed with clearances in compliance with NFPA 80.

B. Test electrified hold open devices tied into fire alarm system to confirm release upon activation of fire alarm. Test electrified hardware and access control to verify systems operate as directed in mode of operation. Where hardware is found to be inoperable, repair or replace with new.

3.4 ADJUSTING AND CLEANING

A. Upon substantial completion, make final adjustments to door closers and other items of hardware after balance of heating and ventilating equipment to ensure doors close and latch properly.

B. Clean and polish all exposed hardware surfaces in accordance with manufacturer's recommended procedures.

C. Clean or repair pencil or tool marks from adjacent surfaces damaged or soiled by work of this Section.

D. Recycle cardboard boxes and paper products used in packaging and transport of finish hardware.

3.5 PROTECTION

A. Remove hardware prior to painting or finishing door and frame. Wrap or mask exposed hardware that cannot be removed until date of substantial completion to avoid exposure to paint, solvents, and abuse.
B. Repair or replace hardware damaged during construction at least two weeks prior to date of substantial completion.

3.6 SCHEDULES

A. Should items of hardware not definitely specified be required for completion of the Work, furnish such items of type and quality comparable to adjacent hardware and appropriate for service required.

B. Where items of hardware aren't definitely or correctly specified, are required for completion of the Work, a written statement of such omission, error, or other discrepancy to Architect, prior to date specified for receipt of bids for clarification by addendum; or, furnish such items in the type and quality established by this specification, and appropriate to the service intended.

Manufacturer List

Code	Name
BE	Best Access Systems
NA	National Guard
PR	Precision
ST	Stanley
TR	Trimco

Finish List

Code	Description
AL	Aluminum
626	Satin Chromium Plated
630	Satin Stainless Steel
689	Aluminum Painted
GREY	Grey

Hardware Sets

SET #001 - Utility

Doors: 02

1 ST	Continuous Hinge	662HD UL	AL
1 BE	Storeroom Lockset	9K3-7D15D PEAKS S3	626
1 BE	Closer	HD8016 AF80P	689
1 TR	Kick Plate	NOTE: REG ARM MOUNT K0050 10" x 2" LDW B4E CSK	630
1 TR	Mop Plate	KM050 10" x 1" LDW B4E CSK	630
1 TR	Wall Bumper	1270CX	626
3 TR	Silencer	1229A	GREY

SET #002 - Office

Doors: 03

1 ST	Continuous Hinge	662HD UL	AL
1 BE	Entrance Lockset	9K3-7AB15D PEAKS S3	626
1 TR	Kick Plate	K0050 10" x 2" LDW B4E CSK	630
1 TR	Mop Plate	KM050 10" x 1" LDW B4E CSK	630
1 TR	Wall Bumper	1270CV	630
3 TR	Silencer	1229A	GREY

SET #003 - Toilet

Doors: 04

1 ST	Continuous Hinge	662HD UL	AL
1 BE	Privacy Set	45H-0LT15H VIB	626
1 BE	Closer	HD8016 AF80P	689
1 TR	Kick Plate	K0050 10" x 2" LDW B4E CSK	630
1 TR	Mop Plate	KM050 10" x 1" LDW B4E CSK	630
1 TR	Wall Bumper	1270CV	630
3 TR	Silencer	1229A	GREY

SET #004 - Exterior

Doors: 06

1 ST	Continuous Hinge	662HD UL	AL
1 PR	Exit Device	2103 X EXZ-7EV15KP PH2 RM SNB (2)	630/626
1 BE	Core	1C7 Series PEAKS	626
1 BE	Closer	HD8016 SDST SN134	689
1 NA	Drip Cap	16 A - 4" ODW	
1 630	Kick Plate	K0050 10" x 2" LDW B4E CSK TR	
1 NA	Gasketing	700 NA 1 x 36" 2 x 84"	
1 NA	Door Sweep	200 NA	
1 SP	FRP Threshold	FRP Bumper Style Threshold x Non Skid Finish	

SET #005 – Two Chain Link Man Gates

Doors: EX1, EX2

1 PR	Exit Device	2101	626W

Note: Hinges, closing device, Gate Plate and balance of hardware by Gate manufacturer. Verify and coordinate hardware with Gate manufacturer.

SET #006 – Storage Utility

Doors: 05

1 ST	Continuous Hinge	662HD UL	AL
1 BE	Passage Set	9K3-0N15D S3	626
1 BE	Closer	HD8016 AF80P	689
		NOTE: REG ARM MOUNT	
1 TR	Kick Plate	K0050 10" x 2" LDW B4E CSK	630
1 TR	Mop Plate	KM050 10" x 1" LDW B4E CSK	630
1 TR	Wall Bumper	1270CX	626
3 TR	Silencer	1229A	GREY

SECTION 08 80 00

GLASS AND GLAZING

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

1.2. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.3. SUMMARY

A. This Section includes glazing for the following products and applications:

1. Windows

1.4. RELATED SECTIONS

A. Section 09 51 13 Aluminum Windows

1.5. DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, float glass or fabricated glass, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

1.6. REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.

B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings, Safety Performance Specifications and Methods of Test; 2010.

C. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata

D. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2015).

E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014a.

F. ASTM C1036 - Standard Specification for Flat Glass; 2011.

G. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.

H. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2014.

I. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.

J. ASTM E1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes; 2014a.

K. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2010.

L. ASTM F1233-98 - Standard Test Method for Security Glazing Materials And Systems

M. GANA (GM) - GANA Glazing Manual; 2009.

N. GANA (SM) - GANA Sealant Manual; 2008.

O. GANA (LGRM) - Laminated Glazing Reference Manual; 2009.

P. ICC (IBC) - International Building Code.

Q. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use; 1990 (2004).

R. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2014.

S. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2014.

T. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2014.

U. Unified Facilities Criteria (UFC) 4-010-01: DoD Minimum Antiterrorism Standards for Buildings

V. Unified Facilities Criteria (UFC) 4-020-01: DoD Security Engineering Facilities Planning Manual

1.7. SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Samples: 12-inch-square, for each type of glass product indicated, other than monolithic clear float glass.

C. Glazing Schedule: Use same designations indicated on Drawings.

D. Sealant compatibility and adhesion test reports.

1.8. QUALITY CONTROL

A. Manufacturer Qualifications : Company specializing in manufacturing the products specified and with at least five (5) years experience.

B. Installer Qualifications : Company specializing in performing work of the type specified and with at least five (5) years experience, and approved by glazing manufacturer.

C. Testing Agency Qualifications : Independent firm specializing in performing testing and inspections of the type required.

D. Sealant Compatibility and Adhesion Testing: Use sealant manufacturer's standard test methods to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

E. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201 and ANSI Z97.1.

F. Standards as applicable and required by the current Pennsylvania Department of Labor and Industry Safety Glazing Materials regulations and agencies having jurisdiction, provide safety glass manufactured, tested, permanently labeled and installed per these requirements.

1.9. WARRANTY

A. Special Warranty: Manufacturer's standard form, made out to Owner and signed by manufacturer, in which manufacturer agrees to furnish replacements for units that deteriorate from normal use by developing defects attributable to the manufacturing process, f.o.b. the nearest shipping point to Project site, within warranty period.

1. Coated Glass (Low E Glass)
    a. Defects: Peeling, cracking, and other indications of degradation of metallic coating.
    b. Warranty Period: 10 years from date of Substantial Completion.

2. Insulating Glass:
    a. Deterioration: Failure of hermetic seal resulting in obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1.10. PERFORMANCE REQUIREMENTS – EXTERIOR GLAZING ASSEMBLIES

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Design glass, including comprehensive engineering analysis according to ICC's 2015 International Building Code by a qualified professional engineer, using the following design criteria:

1. Design Wind Pressures: As indicated on Drawings.
    a. Wind Design Data: As indicated on Drawings.
    b. Basic Wind Speed: 90 mph (40 m/s) Importance Factor: 1.15.
2. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.
3. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch (25 mm), whichever is less.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

D. Comply with ASTM E 1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.

E. Seismic Loads : Design and size glazing components to withstand the seismic loads and sway displacement in accordance with IBC 2015 and requirements outlined on structural drawings.

F. Insulating-Glass Certification Program: Permanently marked with certification label of Insulating Glass Certification Council.

G. Thermal and Optical Performance : Provide glass products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:

1. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBNL's WINDOW 6.3 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
2. Solar Heat-Gain Coefficient: Center-of-glazing values, according to NFRC 200 and based on LBNL's WINDOW 6.3 computer program.
3. Visible Light Reflectance and Visible Light Transmittance: Center-of-glazing values, according to NFRC 300.

PART 2 - PRODUCTS

2.1. GLASS PRODUCTS, GENERAL

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

1. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.
2. 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. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

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

1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick
2. For laminated-glass lites, properties are based on products of construction indicated.
3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.

2.2. MANUFACTURERS

A. Float Glass Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

1. PPG Industries (Basis of Design)
2. Pilkington.

3. Guardian
4. Manufacturer as approved by Architect.

B. Laminated Glass Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

1. Cardinal Glass Industries
2. Viracon
3. Manufacturer as approved by Architect.

2.3. GLASS MATERIALS

A. Annealed Float Glass: Comply with ASTM C 1036, Type I (transparent clear glass, flat), Quality q3 (glazing select).

B. Heat Strengthened and Fully Tempered Float Glass: Comply with ANSI Z97.1, ASTM C 1048 and 16 CFR 1201 (for Fully Tempered); Type I (transparent clear glass, flat); Quality q3 (glazing select).

1. Provide HS (heat-strengthened) coated float glass in place of coated annealed glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in "Performance Requirements" Article. Provide FT (fully tempered) where safety glass is indicated.
2. Provide Kind HS (heat-strengthened) coated float glass, except provide Kind FT (fully tempered) products where coated safety glass is indicated.

C. Insulating-Glass Units: Preassembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 774 for Class CBA units and with requirements specified in this Article.

1. Provide FT (fully tempered).
2. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated in the Insulating-Glass Schedule at the end of Part 3 are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.
3. Sealing System: Dual seal per manufacturer’s standard.
4. Spacer: Standard
5. Corner Construction: Manufacturer's standard
6. Interspace Content: Argon.

2.4. MONOLITHIC FLOAT-GLASS SCHEDULE

A. Uncoated Clear Fully Tempered Float Glass, Class 1, Kind FT (fully tempered).

2.5. INSULATED GLAZING SCHEDULE

A. Type IGU1: Dual Glazed 1" Insulated Glass

1. Outer Lite: Clear tempered, 1/4" Thickness
2. Inner Lite : Clear tempered PPG Solarban 60 (#3) surface, 1/4"

B. Type IGU1P: Dual Glazed 1" Insulated Privacy Glass

1. Outer Lite: Clear tempered VITRO Solarban 60 (#2) surface, 1/4" Thickness

2. Inner Lite : Clear tempered 1/4" Thickness; Full 100% opacity translucent ceramic frit pattern (#4) surface.

2.6. GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:

1. EPDM complying with ASTM C 864.
2. Silicone complying with ASTM C 1115.
3. Thermoplastic polyolefin rubber complying with ASTM C 1115.

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

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

C. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock-strips, complying with ASTM C 542, black.

2.7. GLAZING SEALANTS

A. General:

1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. CFR 59, Subpart D.
4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Dow Corning Corporation; 790.
    b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
    c. May National Associates, Inc.; Bondaflex Sil 290.
    d. Pecora Corporation; 890.
    e. Sika Corporation, Construction Products Division; SikaSil-C990.
    f. Tremco Incorporated; Spectrem 1.

C. Applications: Where recommended by glass manufacturer for use with glazing tape.

2.8. GLAZING TAPES

A. Back-Bedding Mastic Glazing Tape: Preformed, butyl-based elastomeric tape with a solids content of 100 percent with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.9. MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

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

C. Setting Blocks: Elastomeric material with a Shore A durometer hardness of 85, plus or minus 5.

D. Spacers: Super Spacer-Tri-Seal, by EdgeTech or equal manufacturer continuous blocks with a Shore A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Framing Angles for Fire-Protection-Rated Glazing: Provide steel angles for fire-protection rated glazing in wall construction as recommended by the glazing manufacturer.

2.10. FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

A. Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing standard, to comply with system performance requirements.

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.

1. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
2. Protect glass edges from damage during handling and installation. Remove glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance from Project site and legally dispose of off Project site.
3. Apply primers to joint surfaces where required for adhesion of sealants, as determined by sealant compatibility and adhesion testing.
4. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

B. Protection:

1. 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.
2. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter.

C. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged, including natural causes, accidents, and vandalism, during construction period.

3.2. INSTALLATION

A. Glazing Standards: Install glazing with written instructions of glass, gaskets and other glazing material manufacturers, unless more stringent requirements are indicated, including those in referenced glazing standards.

B. Install glazing sealants in accordance with ASTM C1193, GANA (SM) and manufacturer's instructions.

C. Glazing shall not be done when the temperatures are below 40 degrees Fahrenheit. When circumstances require the glazing below 45 degrees Fahrenheit, steps shall be taken to assure clean, dry and frost-free surfaces as approved by the Architect.

D. Channel Glazing: All glass to be set with a minimum of 1/8" spacers on both sides of glass with setting blocks at quarter points. Against rabbet and channel, apply butyl tape. Cut off tape flush with channel and stop.

E. Neoprene Beads: Glass in aluminum door frames and screens held by neoprene extruded beads, snap-in type shall be inserted into stops with slight buttering at corners with channel glazing compound. Install glass per manufacturer's instructions.

3.3. CLEANING AND REPLACEMENT

A. This contractor shall properly protect all glass installed by him from injury or breakage during construction of the building. The contractor shall assume all responsibility for breakage by whoever caused and shall replace all cracked, broken, scratched or otherwise defective glass when directed to do so by the Architect.

B. Wash, rinse and dry glass at frequent intervals during construction in accordance with manufacturers' recommendations.

END OF SECTION 08 80 00

SECTION 08 90 00

LOUVERS

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. SUMMARY

A. Section Includes:

1. Fixed, extruded-aluminum louvers.

B. Related Sections:

1. Division 06 Section “Rough Carpentry” for wood blocking.

1.3. DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

B. Horizontal Louver: Louver with horizontal blades; i.e., the axes of the blades are horizontal.

C. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

1. Provide this type at architectural non-functional louvers with sheet metal back panels. See wall sections for surrounding wall assemblies.

D. Storm-Resistant Louver: Louvers with horizontal blades that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

1. Provide this type at functional louvers.

1.4. PERFORMANCE REQUIREMENTS

A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural performance requirements and design criteria indicated.

B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

1. Wind Loads: Determine loads based on pressures as indicated on Drawings.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

D. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

1.5. SUBMITTALS

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

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
2. Show mullion profiles and locations.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification: For each type of metal finish required.

E. Delegated-Design Submittal: For louvers indicated to comply with structural performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

F. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

1.6. QUALITY CONTROL

A. Source Limitations: Obtain louvers and vents from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."
3. AWS D1.6, "Structural Welding Code - Stainless Steel."

C. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

1.7. PROJECT CONDITIONS

A. Field Conditions: Examine framing and wall substrate conditions prior to fabrication of louvers.

B. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1. MATERIALS

A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T5, T-52, or T6.

B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Aluminum Castings: ASTM B 26/B 26M, Alloy 319.

D. Fasteners: Use types and sizes to suit unit installation conditions.

1. Use Phillips flat-head screws for exposed fasteners unless otherwise indicated.
2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
3. For color-finished louvers, use fasteners with heads that match color of louvers.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2. ACCESSORIES

A. Treated wood blocking for shimming and miscellaneous framing.

2.3. FABRICATION, GENERAL

A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

1. Frame Type: Channel unless otherwise indicated.

D. Include supports, anchorages, and accessories required for complete assembly.

E. Provide vertical mullions of type and at spacings indicated, but not more than recommended by manufacturer, or 72 inches (1830 mm) o.c., whichever is less.

1. Fully Recessed Mullions: Where indicated, provide mullions fully recessed behind louver blades. Where length of louver exceeds fabrication and handling limitations, fabricate with close-fitting blade splices designed to permit expansion and contraction.
2. Exposed Mullions: Where indicated, provide units with exposed mullions of same width and depth as louver frame. Where length of louver exceeds fabrication and handling limitations, provide interlocking split mullions designed to permit expansion and contraction.

F. Provide subsills made of same material as louvers for recessed louvers.

G. Join frame members to each other and to fixed louver blades with fillet welds, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.4. FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Horizontal Storm-Resistant Louver:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    a. Air Balance Inc.
    b. Air Flow Company, Inc.
    c. Airolite Company, LLC
    d. All-Lite Architectural Products.
    e. American Warming and Ventilating, Inc.
    f. Arrow United Industries;
    g. Construction Specialties, Inc.
    h. Greenheck Fan Corporation.
    i. Industrial Louvers, Inc.
    j. NCA Manufacturing, Inc.
    k. Nystrom Building Products.
    l. Reliable Products, Inc.
    m. Ruskin Company; Tomkins PLC.
    n. United Enertech Corp.
2. Louver Depth: 4 inches (100 mm).
3. Frame and Blade Nominal Thickness: Not less than 0.060 inch (1.52 mm) for blades and 0.080 inch (2.03 mm) for frames.
4. Louver Performance Ratings:
    a. Free Area: Not less than 8 sq. ft. for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.
    b. Wind-Driven Rain Performance: Not less than 99 percent effectiveness when subjected to a rainfall rate of 3 inches (75 mm) per hour and a wind speed of 29 mph (13 m/s) at a core-area intake velocity of 300 fpm (1.5 m/s).
5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.5. LOUVER SCREENS

A. General: Provide screen at louvers indicated.

1. Screen Location for Fixed Louvers: Interior face.
2. Screening Type: Insect screening.

B. Secure screen frames to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches (150 mm) from each corner and at 12 inches (300 mm) o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.

1. Metal: Same kind and form of metal as indicated for louver to which screens are attached.
2. Finish: Mill finish unless otherwise indicated.
3. Type: Rewirable frames with a driven spline or insert.

D. Louver Screening for Aluminum Louvers:

1. Insect Screening: Aluminum, 18-by-16 (1.4-by-1.6-mm) mesh, 0.012-inch (0.30-mm) wire.

2.6. FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.7. ALUMINUM FINISHES

A. High-Performance Organic Finish: 2-coat fluoropolymer finish complying with AAMA 2604 and containing not less than 50 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1. EXAMINATION

A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

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

3.2. PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3. INSTALLATION

A. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

F. Protect unpainted galvanized and nonferrous-metal surfaces that will be in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

G. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Division 07 Section "Joint Sealants" for sealants applied during louver installation.

H. Provide blocking as needed for a complete installation.

3.4. ADJUSTING AND CLEANING

A. Test operation of adjustable louvers and adjust as needed to produce fully functioning units that comply with requirements.

B. Clean exposed surfaces of louvers and vents that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

C. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

D. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 08 90 00

SECTION 09 29 00

GYPSUM WALLBOARD

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. SUMMARY

A. This Section includes the following:

1. Interior gypsum board.

1.3. SUBMITTALS

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

1.4. QUALITY CONTROL

A. Fire-Resistance-Rated Assemblies: For scheduled 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.

1.5. STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.6. PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install interior products until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1. PANELS, GENERAL

A. Recycled Content: Provide gypsum panel products with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of 10 percent by weight.

B. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.2. 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. CertainTeed.
    b. G-P Gypsum.
    c. Lafarge North America Inc.
    d. National Gypsum Company.
    e. Temple-Inland.
    f. USG Corporation.

B. Regular Type:

1. Thickness: As indicated.
2. Long Edges: Tapered.

C. Ceiling Type: Manufactured to have more sag resistance than regular-type gypsum board.

1. Thickness: 1/2 inch (12.7 mm).
2. Long Edges: Tapered.

2.3. TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, or rolled zinc at outside corners.
    a. Paper-faced galvanized steel sheet type may be used at inside corners.
2. Shapes:
    a. Cornerbead.
    b. LC-Bead: J-shaped; exposed long flange receives joint compound.
    c. Expansion (control) joint.
3. Provide outside corner trims in full length pieces for length of corners.
4. At overhead bulkheads/soffits segemented corners may be assembled in pieces where the length of the corner condition exceeds manuf. standard full lengths.
    a. Piece segments tight where mulitiple pieces are required to accomplish installation.

2.4. JOINT TREATMENT MATERIALS

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

B. Joint Tape:

1. Interior Gypsum Wallboard: Paper.

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

2.5. 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.

C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.

D. Acoustical Sealant: As specified in Division 07 Section "Joint Sealants."

PART 3 - EXECUTION

3.1. EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

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

3.2. APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. Seal gypsum board and framing construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

1. At fire rated assemblies substitute sealant type in compliance with UL Fire Rated Assembly necessary for the specified fire rating.

J. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.

3.3. APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Type X shall be typical: Vertical surfaces and horizontal surfaces, unless otherwise indicated.
2. Non Type X: for gypsum wallboard conditions specified as 3/8” and 1/2" thick.
3. Type C: Where required for specific fire-resistance-rated assembly indicated.
4. Ceiling Type: As indicated on Drawings other than Moisture and Mold Resistant Type.
5. Abuse-Resistant Type with Type X label: As indicated on Drawings.
6. Moisture- and Mold-Resistant Type: Vertical surfaces and ceilings in spaces subject to moisture and scheduled for finish other than ceramic tile.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.
2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
    a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.4. 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.
2. LC-Bead: Use at exposed panel edges.

3.5. 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 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: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for tile.
3. Level 3: Where indicated on Drawings.
4. Level 4: At panel surfaces that will be exposed to view, unless otherwise indicated.
    a. Primer and its application to surfaces are specified in other Division 09 Sections.
5. Level 5: Ceilings in shower and changing rooms.
    a. Primer and its application to surfaces are specified in other Division 09 Sections.

3.6. 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 09 29 00

SECTION 09 65 13

RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. SUMMARY

A. Section Includes:

1. Resilient base.
2. Resilient molding accessories.

B. Related Sections:

1. Section 09 65 19 – Resilient Flooring

1.3. SUBMITTALS

A. Product Data: Submit product data for each type of product indicated.

B. Samples for Verification:

1. For each type of product indicated, submit the manufacturer's full color line or sample binder for the product line. Samples may be of manufacturer's standard sample size.
2. Provide a sample section not less than 6-by-9-inch (152-by-230-mm) for each product and finish referenced in Division 09.

C. Qualification Data: For qualified Installer.

D. Maintenance Data: For each type of base to include in maintenance manuals.

1.4. QUALITY CONTROL

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for product installation.

1. If required by the product manufacturer, engage an installer who employs workers for this Project who are trained or certified by manufacturer for installation techniques required.

1.5. REFERENCE STANDARDS

A. ASTM F1861, Standard Specification for Resilient Wall Base, Type TV (vinyl, thermoplastic), Group 2 (solid, layered), Style A&B (Straight, Cove)

B. ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials, Class A

C. ASTM E648 (NFPA 253), Standard Test Method for Critical Radiant Flux, Class 1, >0.45 W/cm²

D. ASTM E662 (NFPA 258), Standard Test Method for Smoke Density, Passes, <450

E. ASTM F137, Standard Test Method for Flexibility of Resilient Flooring Materials protocols, Passes

F. ASTM F386, Standard Test Method for Thickness of Resilient Flooring Materials Having Flat Surfaces, Passes

G. ASTM F925, Standard Test Method for Resistance to Chemicals of Resilient Flooring, Excellent

H. ASTM F1515, Standard Test Method for Measuring Light Stability of Resilient Flooring protocols, Passes

I. NFPA 253, Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Energy Source

J. NFPA 255, Standard Method of Test of Surface Burning Characteristics of Building Materials

K. NFPA 258, Test Method for Specific Density of Smoke Generated by Solid Materials

1.6. DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.7. PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

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

1.8. EXTRA MATERIALS

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

1. Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

PART 2 - PRODUCTS

2.1. PRODUCT AND FINISH SCHEDULE:

A. Refer to the Room Finish Schedule.

2.2. RESILIENT BASE

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. Roppe Corporation, U.S.A.
    a. Accepted Products:
        (1) Thermoplastic Vinyl (TV) Wall Base
2. Flexco, Corp.
3. Tarkett Company, Johnsonite

B. Resilient Base Standard: ASTM F 1861.

1. Style: Cove (base with toe).
2. Minimum Thickness: 0.125 inch (3.2 mm).
3. Height: 6 inches (102 mm).
4. Lengths: Cut lengths from manufacturer's standard seamless roll length.
5. Outside Corners: Preformed.
6. Inside Corners: Preformed.
7. Finish, Colors & Patterns: Please reference the room material and product color schedule.

2.3. RESILIENT MOLDING ACCESSORIES

A. Description: Nosing for resilient floor covering, and transition strips.

B. Manufacturers:

1. Accessory manufacturers shall correspond with rubber base manufacturer when available for optimum color and finish coordination.

C. Characteristics:

1. Material Requirement: Thermoplastic vinyl.
2. Profile and Dimensions: As indicated.
3. Color: Colors shall be selected for accessories from any of the manufacturer's full available color lines.

2.4. INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit products and substrate conditions indicated.

1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
    a. Cove Base Adhesives: Not more than 50 g/L.

PART 3 - EXECUTION

3.1. EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

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

3.2. PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. 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.

E. Before applying the manufacturer’s recommended adhesive, thoroughly clean product backing to remove contaminates which could interfere with the bonding process by following manufacturer’s recommended instructions. Once cleaned, allow backing to dry completely before applying adhesive.

3.3. RESILIENT BASE INSTALLATION

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

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

3.4. CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.

B. Perform the following operations immediately after completing resilient product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient products until Substantial Completion.

E. Keep furniture, fixtures and rolling traffic off for first 72 hours.

F. No maintenance for first 72 hours.

3.5. INITIAL MAINTENANCE PROCEDURES

A. General: Include in contract sum cost for initial maintenance procedures and execution by professional maintenance personnel after flooring installation as recommended by flooring manufacturer.

B. Initial maintenance "Starter Kit" supplied by manufacturer. Initial maintenance to be conducted by flooring contractor.

END OF SECTION 09 65 13

SECTION 09 65 19

RESILIENT FLOORING

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. SUMMARY

A. Section Includes:

1. Vinyl Composition Tile

B. Related Sections:

1. Section 09 65 13 – Resilient Base and Accessories

1.3. SUBMITTALS

A. Product Data: Submit product data for each type of product indicated.

B. Samples for Verification:

1. For each type of product indicated, submit the manufacturer's full color line or sample binder for the product line. Samples may be of manufacturer's standard sample size.
2. Provide a sample section not less than 6-by-9-inch (152-by-230-mm) for each product and finish referenced in Division 09 Specifications.

C. Qualification Data: For qualified Installer.

D. Maintenance Data: For each type of floor covering to include in maintenance manuals.

1.4. QUALITY CONTROL

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for product installation.

1. If required by the product manufacturer, engage an installer who employs workers for this Project who are trained or certified by manufacturer for installation techniques required.

B. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.5. DELIVERY, STORAGE, AND HANDLING

A. Store floor coverings and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

B. Sheet Flooring: Store rolls upright.

1.6. PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor converings during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

C. Close spaces to traffic during floor covering installation.

D. Close spaces to traffic for 48 hours after floor covering installation.

E. Install floor coverings after other finishing operations, including painting, have been completed.

1.7. EXTRA MATERIALS

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

1. Floor Tile: Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

PART 2 - PRODUCTS

2.1. PRODUCT AND FINISH SCHEDULE:

A. Refer to the Room Finish Schedule

2.2. VINYL COMPOSITION TILE

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. Armstrong World Industries, Inc.
   a. Manufacturer's Address:
   2500 Columbia Avenue, P. O. Box 3001
   Lancaster, PA 17604 Phone: 717-397-0611
2. Johnsonite, a Tarkett Company
   a. Manufacturer's Address:
   16910 Munn Road
   Chagrin Falls, Ohio 44023 Phone: 440-543-8916
3. Congoleum
   a. Manufacturer's Address
   b. Department C
   c. P.O. Box 3127
   d. Mercerville, NJ 08619-0127

B. Accepted Products:

1. Armstrong World Industries, Inc.
   a. Safety Zone Slip Resistant Tile 1/8”
      Tile size 12” square
2. Other acceptable manufacturers include Johnsonite, Congoleum or other manufacturer as approved by Architect.

C. Colors: Colors shall be selected by the Architect from standard available product line. Contractor will guarantee materials will be available at time of laying by purchasing the tile in ample time before installation. Some products may require additional lead time for manufacturing.

2.3. INSTALLATION MATERIALS

A. Adhesives: Water-resistant type recommended by manufacturer to suit products and substrate conditions indicated.

1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
   a. VCT, and Solid Vinyl Tile Adhesives: Not more than 50 g/L.

B. Floor Cleaner: Provide liquid floor products as recommended by manufacturer for cleaning and protection of finish.

C. Rubber/Vinyl Edging Strip

1. Where resilient flooring abuts other floor finishes and no other threshold or edging is provided, install a thin line type edging of heavy gauge plastic to protect exposed edges of tile.
2. Provide edge strip at exposed edge at bottom shelf of student wardrobes.
3. Provide metal edging strip where resilient flooring system abuts porcelain or ceramic tile. Provide Schluter Systems stainless steel or brushed aluminum tile edging materials at this type of condition.

2.4. FLASH-PATCHING UNDERLAYMENT

A. ACCEPTABLE MANUFACTURERS

1. W.R. Meadows Meadow Patch T1
2. Ardex SD-P
3. Laticrete L&M Duracrete
4. Or equal as approved by the Architect.

B. Contractor shall provide “flash-patching” underlayment as needed to correct out-of-tolerance slab conditions prior to installation of finish flooring.

1. Flash-patching underlayment shall be compatible with the specified finish flooring materials.
2. Flash patching underlayment shall only be used for repairing incidental/isolated unsuitable surface conditions in need of correction before finish flooring installation.

3. Flash patching underlayment shall not be used as a means of floor leveling. The product shall be for minor repairs and shall be capable of being applied to transition to a feather edge thickness at the boundary of patched areas.
4. Flash patching materials shall not be used on concrete floor slabs where their surfaces are to remain exposed as part of the final finish.

PART 3 - EXECUTION

3.1. EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor coverings.

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

3.2. PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of floor coverings.

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 floor covering adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
4. Moisture Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
    a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
    b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have maximum 75 percent relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

1. Also scrape, grind or polish floor substrate to remove all debris and dirt from floor substrate surface prior to VCT installation, otherwise work will be rejected for not meeting intent should dirt and debris translate with an uneven floor surface.

D. Do not install floor coverings until they are same temperature as the space where they are to be installed.

1. Move floor coverings 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 floor coverings immediately before installation.

3.3. FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles square with room axis or in pattern indicated in the Color and Material Schedule.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles with grain direction alternating in adjacent tiles (basket-weave pattern) or in pattern of colors and sizes .

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.

3.4. CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of floor coverings.

B. Perform the following operations immediately after completing floor covering installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect floor coverings from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Treatment: Remove soil, visible adhesive, and surface blemishes from floor coverings before applying floor treatment products.

E. Contractor shall repair or replace all damaged floor covering before acceptance; flooring shall be properly protected in approved manner until final completion of other work.

F. Post-installation Cleaning:

1. Never saturate floor with water; keep water to a minimum.
2. Remove surplus adhesive from newly laid floor before adhesive has set, using a damp cloth.
3. Allow adhesive to set completely according to manufacturer's instructions.
4. Vacuum thoroughly removing all sand, dirt and grit.
5. Damp mop floor thoroughly with a neutral pH detergent, using a wet mop applicator; wring mop thoroughly prior to applying to floor.

G. No maintenance for first 48 hours or time period recommended by manufacturer.

H. Cover floor tile until Substantial Completion.

I. Vinyl Flooring Materials: Follow manufacturer’s recommendation and provide initial waxing of flooring after installation just prior to substantial completion. Consult with User Agency prior to installation regarding type of floor wax being used.

3.5. INITIAL MAINTENANCE PROCEDURES

A. General: Include in contract sum cost for initial maintenance procedures and execution by professional maintenance personnel after flooring installation as recommended by flooring manufacturer.

B. Initial maintenance "Starter Kit" supplied by manufacturer. Initial maintenance to be conducted by flooring contractor.

END OF SECTION 09 65 19

SECTION 09 91 23

INTERIOR PAINTING

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. SUMMARY

A. Section includes surface preparation and the application of paint systems on interior substrates**.**

1. Gypsum board.

1.3. DEFINITIONS

A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523, a matte flat finish.

B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523, a high-side sheen flat, velvet-like finish.

C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523, an eggshell finish.

D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523, a satin-like finish.

E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523, a semi-gloss finish.

F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523, a gloss finish.

1.4. ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

B. Samples for Initial Selection: For each type of topcoat product.

C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches (200 mm) square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

3. VOC content.

1.5. CLOSEOUT SUBMITTALS

A. Coating Maintenance Manual: Provide coating maintenance manual including area summary with finish schedule, area detail designating location where each product/color/finish was used, product data pages, material safety data sheets, care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.

1.6. MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials only as left over from construction activities. Deliver to the client agency for use as attic stock.

1.7. DELIVERY, STORAGE, AND HANDLING

A. Delivery and Handling: Deliver products to Project site in an undamaged condition in manufacturer's original sealed containers, complete with labels and instructions for handling, storing, unpacking, protecting, and installing. Packaging shall bear the manufacture's label with the following information:

1. Product name and type (description).
2. Batch date.
3. Color number.
4. VOC content.
5. Environmental handling requirements.
6. Surface preparation requirements.
7. Application instructions.

B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.8. FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company products indicated or comparable product from one of the following:

1. Benjamin Moore & Co.
2. PPG Architectural Finishes, Inc.

B. Source Limitations: Obtain paint materials from single source from single listed manufacturer.

1. Manufacturer's designations listed on a separate color schedule are for color reference only and do not indicate prior approval.

2.2. PAINT, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

B. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 150 g/L.
3. Dry-Fog Coatings: 400 g/L.
4. Primers, Sealers, and Undercoaters: 200 g/L.
5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
7. Pretreatment Wash Primers: 420 g/L.
8. Floor Coatings: 100 g/L.
9. Shellacs, Clear: 730 g/L.
10. Shellacs, Pigmented: 550 g/L.

D. Low-Emitting Materials: Interior paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Colors: As selected by Architect from manufacturer's full range

PART 3 - EXECUTION

3.1. EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers. Where acceptability of substrate conditions is in question, apply samples and perform in-situ testing to verify compatibility, adhesion, and film integrity of new paint application.

1. Report, in writing, conditions that may affect application, appearance, or performance of paint.

B. Substrate Conditions:

1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

a. Gypsum Board: 12 percent.

2. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

C. Proceed with coating application only after unsatisfactory conditions have been corrected; application of coating indicates acceptance of surfaces and conditions.

3.2. PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

3.3. APPLICATION

A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed in equipment rooms:
    a. Equipment, excluding panelboardsand switch gear.
    b. Uninsulated metal piping.
    c. Uninsulated plastic piping.
    d. Pipe hangers and supports.
    e. Metal conduit.
    f. Plastic conduit.
    g. Tanks that do not have factory-applied final finishes.
    h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
2. Paint the following work where exposed in occupied spaces:
    a. Equipment, including panelboards.
    b. Uninsulated metal piping.
    c. Uninsulated plastic piping.
    d. Pipe hangers and supports.
    e. Metal conduit.
    f. Plastic conduit.
    g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
    h. Other items as directed by Architect.
3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4. FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5. CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6. INTERIOR PAINTING SCHEDULE

A. Gypsum Board Substrates:

1. Latex System:

a. Prime Coat: Primer, latex, interior**, MPI #149 X-Green**: S-W ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils wet, 1.5 mils dry.

b. Intermediate Coat: Latex, interior, matching topcoat.

c. Topcoat: Latex, interior, flat, **(Gloss Level 1), MPI #53 X-Green/#143 X-Green**: S-W ProMar 200 Zero VOC Latex Flat, B30-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.

(1) Provide flat finish at overhead locations.

d. Topcoat: Latex, interior, eggshell[, **(Gloss Level 3), MPI #52 X-Green/#145 X-Green**]: S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils wet, 1.7 mils dry, per coat.

END OF SECTION 09 91 23

SECTION 10 14 00

SIGNAGE

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. SCOPE

A. Furnish all material, labor and equipment necessary to complete the installation of interior sign types in the building as indicated on the drawings, interior signage schedule and herein specified.

1.3. SUBMITTALS

A. Catalog Data:

1. Manufacturer's illustrated product literature and specifications.
2. Installation instructions including technical data and installations for each type of sign.

B. Shop Drawings:

1. Submit shop drawings which shall be in accordance with the General Conditions.
2. Complete shop drawings listing inscriptions, sign size, letter form, and letter height, including tactile designations.

C. Physical Sample: One of each sign type.

1.4. OUALITY CONTROL

A. Manufacturer to have a minimum of 5 years' experience in manufacturing sign systems and submit 3 references showing products completed within the last 6 years.

B. All products to be manufactured by one manufacturer or to be of consistent quality and appearance if from different manufacturers.

1.5. REFERENCES

A. Americans With Disabilities Act of 1990 and as amended to present.

1. Section 4.30 - Signage.
2. Section 4.30.4- Raised and Brailled Characters and Pictograms.
3. Section 4.30.5 - Finish and Contrast.
4. Section 4.30.6 - Mounting Location and Height.

PART 2 - PRODUCTS

2.1. SPECIFIC CRITERIA FOR SIGNAGE

A. Type Style - Shall be upper case and helvetica in style. Refer to architectural drawings for sign type elevations.

B. Tactile and Braille Characters - Characters shall be raised a minimum of 1/32" and accompanied by Grade 2 Braille.

C. Character Height - Tactile characters shall be between 5/8" and 2" in height and/or per Architect's drawings and specifications.

D. Pictograms (Symbols) - Shall be on a minimum of a 6" high field or background; shall be supplemented by upper case tactile descriptive verbiage and Grade 2 Braille below pictogram. No other graphic can invade the pictogram field. Pictogram itself does not have to be tactile. Provide pictogram and descriptive verbiage accompanied by Grade 2 Braille at locations designated on drawings.

E. Finish and Contrast - Characters and finish shall be matte (non-glare) characters and background shall have a minimum contrast of 70%. Light characters on dark background or dark characters on light background are acceptable.

F. Mounting Conditions - Mount 48"-60" from finish floor to centerline of sign on latch side of door. Where no wall space is provided at the latch side of the door place on nearest adjacent wall so that person can approach to within 3" of signage without protrusions or swing of door .

G. Refer to architectural drawings for signage types.

2.2. FABRICATION

A. Plaque assembly shall be plastic laminate construction. Plastic laminate shall be impervious to most acids, alkalis, alcohol, solvents, abrasives and boiling water. Plastic laminate shall be non-static, fire-retardant, and self-extinguishing.

B. Approximately .080 inch thick non-glare matte acrylic face laminated to approximately 1/8” inch thick acrylic back plate with filler to create windows for inserts, if so indicated. -

C. All non-tactile graphics shall be subsurface or second surface applied.

D. Painted surfaces on signs will not be accepted.

E. Inserts (if applicable): Graphics and lettering pressure sensitive vinyl film applied to first surface.

F. Tactile copy material (where designated): Individual plastic letters or characters shall be one solid color and chemically bonded by the use of a high strength solvent within a matched routed depression in sign face to create graphics which are raised a minimum of 1/32" from the face of sign. Tactile characters 5/8"-2" in height.

G. Braille (if applicable): Grade 2 Braille engraved into face of sign.

H. Plaque assembly shall be mechanically fastened to wall with Phillips head type wood or sheet metal screws in four holes provided in each sign, (one in each corner). Countersink screw head to be flush with sign face. Screw diameter to be approximately 3/32".

I. Corners can be square or radius, sides can be beveled or flat, as shown on drawings.

J. Colors to be selected by Architect, which include custom fabrications based on manufacturer's capabilities.

2.3. ACCEPTABLE MANUFACTURERS

A. Digital Color Graphics 4158 Library Road Pittsburgh, PA 15234 Phone: - (412) - 343-3331 Fax: (412) - 343-3337

B. Belsinger Sign Works, Inc. 1300 Bayard Street Baltimore, MD 21230 Phone: (410) - 837 -2700 Fax: (410) - 837-6550

C. Bayuk Graphic Systems, Inc. 5005 Old Lincoln Highway, Parkesburg, PA 19363; telephone (717) 442-0274; fax (717) 442- 1289

D. Or equal as approved by the Architect.

2.4. SIGNAGE SCHEDULE

A. Contractor shall prepare a signage schedule indicating specific room names and numbers as indicated on the Drawings.

B. Schedule shall include the appropriate number of letter lines of text as required for each individual room, based on the room name.

PART 3 - EXECUTION

3.1. INSTALLATION

A. Install graphic signage systems in accordance with manufacturer's written installation instructions and shop drawings.

B. Install signs level, plumb, and at the height indicated. Sign surfaces shall be free from distortion or other visual defects.

C. Signs shall be mounted in compliance with 2010 ADA Standards for Accessible Design, ANSI A117.1-2015 Accessible and Useable Buildings and Facilities.

3.2. CLEANING AND PROTECTION

A. Clean all surfaces following installation.

3.3. SCHEDULE

A. Provide signs in quantities indicated as follows:

1. Sign Type 1 : Provide three signs
2. Sign Type 2 : Provide 1 sign

3. Sign Type 3 : Provide 1 sign

END OF SECTION 10 14 00

SECTION 10 28 00

TOILET, BATH AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. SUMMARY

A. Section Includes:

1. Washroom accessories.
2. Not all accessories specified herein are included in the project. Refer to drawings for coordination.

B. Refer to drawings and Toilet Accessory Schedule for scheduled accessories and quantities.

C. All items specified in this section may not be included on the project scope. Refer to Drawings for locations and quantities.

1.3. SUBMITTALS

A. Product Data: For each type of product indicated. Include the following:

1. Construction details and dimensions.
2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Material and finish descriptions.
4. Features that will be included for Project.
5. Manufacturer's warranty.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.
2. Identify products using designations indicated.

C. Maintenance Data: To include maintenance manuals.

D. Warranty: Sample of special warranty.

1.4. QUALITY CONTROL

A. Source Limitations: Where possible, obtain products from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.5. COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.6. WARRANTY

A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1. MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.

B. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch (0.9-mm) minimum nominal thickness.

C. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip zinc coating.

D. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

E. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

F. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.2. CLOTHES HOOK (CH1)

A. Basis of Design Product: Model #9134 as manufactured by Bradley or approved equal product.

B. Coat hooks shall be provided at the back of single fixture toilet room doors and where indicated on drawings.

2.3. GRAB BARS (GB-L, GB18, GB30, GB36, GB42, GB48)

A. Furnish stainless steel tubing grab bars as detailed on the drawings constructed entirely of stainless steel polished No.4 satin finish, 1-1/4" outside diameter x .050" wall thickness. All connections shall be brazed to the bar, polished to blend. Mounting shall be by concealed method.

B. Basis-of-Design Product: Model #832-4 as manufactured by Bradley or approved equal product.

C. Grab bars to be provided as shown on drawings with concealed mounting. Use mounting of sleeve type with round head machine bolt, tee-nut of sufficient size to bolt through toilet partition panel and toggle-bolt mounting for mounting on masonry wall.

1. Horizontal and vertical bars of sizes and configurations as indicated on drawings.

2.4. MIRROR (MIRR)

A. Basis-of-Design Product: Model #780 Angle Frame Mirror as manufactured by Bradley.

B. Locations: Provide mirrors in front of sinks in all toilet rooms and locker and locker rooms and as indicated on the Drawings. All mirrors shall be tempered 1/4" thick silvered glass.

C. Mirror Glass: Use twin-ground polished plate (float) glass mirror glazing quality in accordance with U.S. Commercial Standard CS-27-36, copper-protected electrolytically in sizes noted, guaranteed for period of 10 years with No.20 angle- or channel-shaped frame of No.4 polished stainless steel or a No.16 gauge triple chromium-plated brass frame. Fastenings shall be theftproof. The backs of framed mirrors shall be completely covered by a sheet of No. 24 gauge galvanized steel.

D. Satin finish stainless steel angle frame.

E. Types and Sizes:

1. Typical Restrooms: provide 18 inch wide by 36 inch high units over lavatories.
2. Refer to interior elevation drawings where larger mirrors are required.

2.5. LIQUID SOAP DISPENSER (SD)

A. Furnished by the Owner, General Contractor to Install

2.6. PAPER TOWEL HOLDER / DISPENSER (PTH)

A. Furnished by the Owner, General Contractor to Install

2.7. TOILET PAPER HOLDER / DISPENSER (TPH)

A. Furnished by the Owner, General Contractor to Install

2.8. SANITARY NAPKIN DISPOSAL (SND)

A. Basis-of-Design Product: Model #4722-15 Standard Series sanitary napkin disposal as manufactured by Bradley.

1. Satin finish stainless steel
2. Surface mounted

2.9. CUSTODIAL ACCESSORIES

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. Bradley Corporation.
2. A & J Washroom Accessories, Inc.
3. American Specialties, Inc.
4. Bobrick Washroom Equipment, Inc.
5. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
6. Tubular Specialties Manufacturing, Inc.

B. Basis of Design Mop and Broom Holder:

1. Model #9933 as manufactured by Bradley.
   a. 4 hooks, 3 holders
   b. Satin stainless steel finish.

2.10. UNDER SINK PROTECTION (USP)

A. Basis of Design manufacturer: LavGuard 2 as manufactured by Trubro/IPS

1. Approved equal product.

2.11. FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1. INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F 446.

C. Provide fire retardant plywood or fire retardant solid wood blocking at all stud framed walls before installing gypsum board, tile backer board and wall finishes, typical.

3.2. ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 10 28 00

SECTION 10 44 13

FIRE EXTINGUISHER CABINETS

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. SUMMARY

A. Section Includes:

1. Fire protection cabinets for the following:
    a. Portable fire extinguishers.

B. Related Sections:

1. Division 09 painting Sections for field painting fire protection cabinets.
2. Division 10 Section "Fire Extinguishers."

1.3. SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.

1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
2. Show location of knockouts for hose valves.

B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Initial Selection: For each type of fire protection cabinet indicated.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Size: 6 by 6 inches (150 by 150 mm) square.

E. Product Schedule: For fire protection cabinets. Coordinate final fire protection cabinet schedule with fire extinguisher schedule to ensure proper fit and function.

F. Maintenance Data: For fire protection cabinets to include in maintenance manuals.

1.4. COORDINATION

A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate size of fire protection cabinets to ensure that type and capacity of fire hoses, hose valves, and hose racks indicated are accommodated.

C. Coordinate sizes and locations of fire protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1. MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

B. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:

1. Extruded Shapes: ASTM B 221 (ASTM B 221M).

C. Transparent Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), 6 mm thick, with Finish 1 (smooth or polished).

2.2. FIRE PROTECTION CABINET

A. Cabinet Type: Suitable for fire extinguisher.

1. Basis of Design: Basis of Design: Larsen's Manufacturing Company; Cameo AL-C-2409-5R. Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. J. L. Industries, Inc., a division of Activar Construction Products Group.
   b. Kidde Residential and Commercial Division, Subsidiary of Kidde plc.
   c. Potter Roemer LLC.

B. Cabinet Construction: Nonrated typical where installed in masonry walls. Provide fire rated in where mounted in metal stud partitions.

C. Cabinet Material: Steel sheet.

1. Shelf: Same metal and finish as cabinet.

D. Semi-recessed Cabinet (Typical Type): 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 semi-recessed cabinet installation.

1. Square-Edge Trim: 1-1/4- to 1-1/2-inch (32- to 38-mm) backbend depth.

E. Cabinet Trim Material: Steel sheet.

F. Door Material: Extruded-aluminum shapes.

G. Door Style: Fully glazed panel with frame.

H. Door Glazing: Break acrylic bubble.

1. Acrylic Bubble Color: Clear, transparent.

I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide manufacturer's standard.
2. Provide manufacturer's standard hinge permitting door to open 180 degrees.

J. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle Finishes:

1. Manufacturer's standard baked-enamel paint for the following:
   a. Exterior of cabinet except for those surfaces indicated to receive another finish.

b. Interior of cabinet.

2. Aluminum: Clear anodic.

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.

1. Weld joints and grind smooth.
2. Provide factory-drilled mounting holes.
3. Prepare doors and frames to receive locks.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch (13 mm) thick.
2. Miter and weld perimeter door frames.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.4. GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.5. ALUMINUM FINISHES

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

2.6. STEEL FINISHES

A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning". After cleaning, apply a conversion coating suited to the organic coating to be applied over it.

B. Factory Prime Finish: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

C. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1. EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where semi-recessed cabinets will be installed.

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

3.2. PREPARATION

A. Prepare recesses for semi-recessed fire protection cabinets as required by type and size of cabinet and trim style.

3.3. INSTALLATION

A. General: Install fire protection cabinets in locations and at mounting heights indicated

1. Fire Protection Cabinets: 54 inches (1372 mm) above finished floor to top of cabinet.

B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Unless otherwise indicated, provide recessed fire protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semi-recessed fire protection cabinets.
2. Provide inside latch and lock for break-glass panels.
3. Fasten mounting brackets to inside surface of fire protection cabinets, square and plumb.

3.4. ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.

E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 10 44 13

SECTION 12 34 00
PLASTIC LAMINATE CASEWORK

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. SCOPE

A. Furnish, deliver to buildings, uncrate and set in place, without mechanical connections, all equipment listed hereinafter and/or shown on drawings.

B. Fixed items, such as counters, base cabinets and wall cabinets shall be scribed to walls, leveled and anchored to floors and to walls and shall be complete with trim strips, fillers, backs, etc., as may be required. All cutouts required for trim, sinks, etc., shall be made by the casework supplier.

1.3. STANDARDS

A. Wherever in the "Equipment Schedule" reference is made to a catalog or manufacturer's number, said reference establishes the general dimensions, minimum standards of design, quality of workmanship and materials, etc., to equalize bidding.

B. Manufacturers shall be members of AWI, have established quality control criteria (to be submitted at the request of the Architect) and have passed all applicable ANSI 161.1 and general static load testing (racking, joint loading, and drawer load static testing) requirements, covering the following areas of product performance:

1. Base cabinet construction/racking test: 800 lbs.
2. Cabinet front joint loading test: 425 lbs.
3. Wall cabinet static load test: 2,200 lbs.
4. Drawer front joint loading test: 600 lbs.
5. Drawer construction/static load test: 635 lbs.
6. Particleboard screw holding power: 300 lbs.

C. Casework produced by manufacturers who have not had the specified products tested per ANS1161.1 is not acceptable.

D. Manufacturers shall comply with special requirements related to the Americans with Disabilities Act, current version.

1.4. SUBMITTALS

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

B. Shop Drawings: Submit in accordance with the provisions of Division 1.

1. Drawings shall show profiles, construction, layout and where required, connections to adjoining work.

2. Furnish casework in a single coordinated submission for review. Furnish same submission to other trades under this contract and to other contractors on the project who have connecting or adjacent work for coordination review and for locating their work connected to or adjacent to the equipment specified herein. Distribute reviewed "Field Use" copies to all affected trades when casework manufacturer and affected contractors have completed coordination necessary for complete installation.

1.5. SITE CONDITIONS

A. Items shall suit space conditions and where equipment is intended to occupy fixed locations, the physical conditions, roughing-in, etc., of the building are to control the absolute sizes and arrangements.

1.6. PRODUCT HANDLING

A. Deliver, store and handle casework in manner to prevent damage and deterioration.

B. All items shall be delivered to the appropriate rooms designated for installation of the casework.

C. Provide packaging such as cardboard or other containers, separators, banding, spreaders and paper wrappings to protect metal items.

D. Store casework in a protected dry area, away from direct sunlight, at least 1" or more off the ground or floor and at least 1" between individual pieces.

E. All cabinets to be complete with hardware attached (or provided loose where not practical to ship attached) with all necessary scribes, fillers and molding. All items to be marked for identification.

F. Loose heating, plumbing and electrical items to be marked for exact installation location.

G. Protect all exposed finish surfaces by suitable means.

1.7. WARRANTEES, GUARANTEES, TESTING

A. The entire installation shall be guaranteed by the Casework Manufacturer for a period of five years from date of acceptance, in addition to the General Contractor’s guarantee, provide manufacturer’s warranty against defects in materials and workmanship. Guarantee shall cover the replacement, without cost to the Owner, of any and all items that shall become defective within the above-stated time.

PART 2 - PRODUCTS

2.1. GENERAL

A. Drawings and specifications for casework and equipment are based upon Steven's Industries, 704 West Main Street, Teutopolis, IL 62467, (217) 540-3100. The specifications outline minimum material and construction standards. Only products meeting or exceeding this minimum standard will be acceptable. The receiving of a bid does not necessarily indicate the manufacturer's standard cabinetry is acceptable. Contractor is required to revise their standard cabinetry to meet the product standards specified. Colors for casework and countertops shall be as selected by the Architect and shall not be limited in number of colors.

B. The following are acceptable manufacturers:

1. Hoff Enterprises
2. Maple Craft USA
3. Wood-Mode
4. Or equal substitution as approved by Architect in accordance with Division 1 specifications

C. The design shall be in accordance with the drawings for each item, complete with all required fillers, trim strips, backs, etc.

D. The equipment of the following specifications shall be the heavier, more substantial grade of equipment generally referred to as Institutional Grade, as compared to the lighter commercial grades that will not comply with these specifications and will not be acceptable.

E. Casework Construction - General

1. All exposed exterior cabinet surfaces shall be surfaced with a high pressure plastic laminate .028 inch (.71 mm) in thickness (GP28), meeting current N.E.M.A. standards for vertical grade and shall be as selected from manufacturer's standard colors.
2. Interior surfaces (concealed surfaces) and underside of wall cabinets shall be neutral in color and be resin impregnated thermofused melamine laminate .020 inch (.51 mm) in thickness, meeting current N.E.M.A. standards. Units, without doors, to receive same interior as exterior.
3. Laminated Plastic Cover: Architect shall have a minimum of 220 standard colors to select from. Some Manufacturers may need to include premium colors to achieve this 220 minimum.
4. Cabinet body leading edges and drawer box edging shall be flat edge .020 inch (.51 mm) polyvinylchloride (PVC), machine applied with hot melt adhesive.
5. Doors and drawer edges and front and rear shelf edges shall be edged with 3mm polyvinylchloride (PVC), machine applied with hot melt adhesive, inside/outside length radiused, comer radiused and buffed.
    a. Provide color options from manufacturers full range of color options from possible multiple manufacturers in order for best color match to selected plastic laminate color. Acceptable manufacturers include but are not limited to: Edge Co., Doelken, American Laminates, and Charter Industries.
6. Drawer bodies shall be of medium density fiberboard (MDF) with resin impregnated thermofused melamine laminate surface, neutral in color, and secured to the plastic laminated drawer front.

7. Lamination with natural hybrid P.V.A Type III water resistant adhesives that cure through chemical reaction, containing no health or environmentally hazardous ingredients, are required. "Contact" methods of laminating are not allowed.
8. Substrate for Laminated Surfaces:
    a. Particleboard:
        (1) Particleboard to be industrial grade, with a minimum density range of 45 to 50 pounds per cubic foot, balanced 3-ply construction with moisture content not to exceed 8% and shall conform to ANSI A208. 1-1993, type M-3.
        (2) Particleboard cabinet components to be of the following minimum core thicknesses prior to lamination:
            (a) Cabinet backs and drawer bottoms 3/8 inches.
            (b) Base and tall cabinet tops and bottoms, cabinet sides, drawer spreaders, door/drawers, shelves, hang rails and exposed cabinet backs 3/4 inches.
            (c) Wall cabinet tops, bottoms, shelving over 27" W. and all exposed shelving 1 inch.
    b. Medium Density Fiberboard (MDF):
        (1) Uniform, medium density conforming to ANSI A208.2 with a minimum screw holding power of 325 lbs., modulus of rupture of 4000 psi and modulus of elasticity of 400,000 psi.
        (2) MDF cabinet components to be of the following minimum core thicknesses prior to lamination:
            (a) Drawer sides, subfront and back 1/2 inches.

F. Countertops
    1. Laminated Plastic:
        a. .050 inch (1.27mm) thickness (GP50), high pressure plastic laminate, which equals or exceeds performance standards set by National Electrical Manufacturers Association (NEMALD3-1991), as amended, for Class 1 applied with water resistant glue over 1-1/4" thick particleboard. Underside shall be properly balanced with heavy gauge backing sheet. Provide tops in as long as practical continuous lengths. Provide field glued splines and mechanical fasteners at joints. The backsplash shall not be the post-formed cove type. Backsplashes will be mechanically fastened to countertops by means of Smart Clips, spaced 12 inches on center. Backsplash bottom and corner joints will be continuously sealed with silicone sealant.

G. Cabinet Construction
    1. Subbase:
        a. Cabinet Subbase: To be separate and continuous (no cabinet body sides-to-floor), water-resistant exterior grade plywood with concealed fastening to cabinet bottom. Ladder-type construction of front, back and intermediates, to form a secure and level platform to which cabinets attach
    2. Cabinet Top and Bottom:

a. Base and tall cabinet bottoms to be neutral colored, thermofused laminated particleboard on concealed interior side, and high pressure plastic laminate on exposed surface, 314" thick with phenolic neutral colored backer sheet on concealed side.

b. Solid subtop to be neutral colored, thermofused laminated particleboard both sides, 314" thick, and furnished for all base and tall cabinets.

c. Wall cabinet and library shelving bottoms and tops are to be 1" thick.

d. Exterior exposed wall cabinet bottoms to be neutral colored thermofused melamine laminate. Assembly devices to be concealed on bottom side of wall cabinets.

3. Cabinet Ends:

a. Exposed ends shall be 13/16" in thickness, consisting of high-pressure plastic laminate of a selected color on one side and thermofused melamine laminate of a neutral color on opposite side of a particleboard substrate.

b. Concealed ends shall be 13/16" in thickness consisting of thermofused melamine laminate, neutral in color, on both sides of a particleboard substrate.

c. Edging shall be .020" polyvinylchloride.

d. Holes drilled for adjustable shelves to be 1-1/4" (32mm) on center.

e. Tops, top rails, bottoms, intermediate rails and/or panels shall be joined to the cabinet ends by means of a permanent locking mechanical fastener. This fastener shall be concealed at all joints of cabinet resulting in a clean, tight joint the full depth of cabinet.

4. Cabinet Backs:

a. Backs of base and tall cabinets shall be 3/8" thick, faced on exposed side with a neutral colored, thermofused melamine laminate on concealed surface and high pressure plastic laminate on exposed surface, and on reverse side with a backer sheet, and shall be let into cabinet sides, top and bottom and further secured by means of self-expanding staples into the cabinet top, bottom and intermediate panel. Backs shall be inset 3/4" from rear of cabinet body to permit accurate scribing to wall. Rear, unexposed, side of back to receive continuous bead of hot melt adhesive at joint between back and sides, top and bottom for sealing against moisture and vermin, and further contribute to case rigidity.

b. 3/4" thick hang rails shall be glued to rear of cabinet back and mechanically fastened to cabinet sides. Provide minimum of 2 at base, 2 at wall" and 3 at tall cabinets.

c. Exposed exterior backs to be 3/4" thick particleboard faced with high-pressure plastic laminate.

d. Removable backs, where specified, shall be retained in vertical cleats secured to the cabinet ends to provide tight joints yet be conveniently removable for access to plumbing and electrical.

5. Drawers:

a. Drawer sides, back and front shall be, *1/2"* in thickness, thermofused melamine laminated MDF. Sides shall be dadoed to receive front and back and further secured with hot melt glue and expanding staples into the drawer body front and back. Drawer bottoms shall be 3/8" in thickness of thermofused melamine laminated particleboard, fitted and secured into grooved drawer front, sides and back. Underside of drawer to receive continuous bead of hot melt adhesive for sealing against moisture and vermin, and further contribute to drawer rigidity. Reinforce drawer bottoms with 1/2" x 4" front-to-back intermediate underbody stiffener, hot melt glued and fastened. One at 24", 2 at 36" and 3 at 48". Drawer bodies shall be secured to plastic laminated drawer fronts.

b. Drawer Slides:

(1) Standard Drawers: Self-closing design, epoxy powder coated to match drawer body color, with positive in-stop, out-stop and out-keeper to maintain drawer in 80% open position. Captive nylon rollers, both front and rear. Minimum 100 lb. dynamic load rating. Provide adjuster cam to regulate body side sway.

(2) File Drawers: Full extension, 3 part progressive opening slide, minimum 150 lb dynamic load rating, zinc plated or epoxy coated at manufacturer's option.

(a) Provide body mounted molded rails for hanging file system for legal or letter size as indicated by manufacturer's model number. Cutting or machining of drawer body/face not allowed.

(3) Paper Storage Drawers: Full extension, 3-part progressive opening slide, minimum 150 lb dynamic load rating, zinc plated or epoxy coated finish.

6. Door and Drawer Fronts:

a. Hinged and sliding doors and drawer fronts shall be 13/16" in thickness consisting of high pressure plastic laminate, of color selected, on exposed side and thermofused melamine laminate, neutral in color, on opposite side of a particleboard substrate.

b. Drawer fronts and hinged doors are to overlay the cabinet body, maintaining a maximum 1/8" reveal between all doors and drawers.

c. Edging shall be 3mm polyvinylchloride.

d. Stile and rail doors shall be 13/16" in thickness consisting of high pressure plastic laminate, of color selected, on exposed side and thermofused melamine laminate, neutral in color, on opposite side of a MDF substrate, with full1/4" tempered glass lite, trimmed and glazed with extruded vinyl glazing bead.

7. Fixed and Adjustable Shelves:

a. Shelves shall consist of high pressure plastic laminate on both sides where exposed and thermofused melamine laminate on both sides where concealed. Core shall be 3/4" thick particleboard on shelves up to 27" long and 1" thick on shelves 30" long and over. Shelves shall be full depth of cabinet and adjustable the full height of cabinet.

b. Front and rear edge shall be 3mm polyvinylchloride.

c. Shelf thickness at all widths of open cabinets, to be 1" in thickness.

8. Integral Sinks:

a. Sinks shall be constructed of #14 gauge stainless steel with corners formed with a ¾” radius, both horizontal and vertical. Sink sizes as scheduled.

H. Special Cabinet Construction

1. Wall Cabinets:
    a. Tops shall be 1" particleboard with thermofused melamine laminate, neutral in color, on both sides. Cabinet tops to be flush.
    b. Tops with exposed interiors shall be laminated with high-pressure plastic laminate of a selected color on one side and thermofused melamine laminate, neutral in color, on both sides.
    c. Bottoms shall be 1" particleboard with thermofused melamine laminate, neutral in color, on both sides.
    d. Bottoms with exposed interiors shall be laminated with high-pressure plastic laminate of a selected color on one side and thermofused melamine laminate, neutral in color, on bottom surface of 1" particleboard substrate.
    e. Edging shall be .020 polyvinylchloride.
2. Tall Casework:
    a. Tops shall be 13/16" particleboard with thermofused melamine laminate, neutral in color, on both sides. Cabinet tops to be flush.
    b. Bottom shall be 13/16" particleboard with thermofused melamine laminate, neutral in color, on both sides.

2.2. HARDWARE

A. Materials

1. Hinges for all base cabinets, wall cabinets and tall casework doors shall be of the full wrap-around, five knuckle pin, heavy-duty institutional type with hospital tip and rounded ends, 2-3/4" high x .095" minimum thickness, 270 degree swing, of tempered steel. Hinges shall be finished in color selected from manufacturer's standard colors. Offset kitchen cabinet type, plain butt hinges with removable pins will not be acceptable. All hinge screws shall be concealed when door is closed. Doors under 48" high shall have two hinges and those over 48" high shall have three hinges. Doors and drawers to be fitted with silencer bumpers.
2. Pulls shall be aluminum 4" on center wire pulls, color selected from manufacturer's standard colors.
3. Adjustable shelf supports to be twin pin design with anti-tip up shelf restraints for both ¾" and 1" thick shelves, and provide slot to mechanically fasten shelf to clip. Load rating minimum of 300 lbs per support.
4. Locks to be disc tumbler type lock with cabinets keyed alike per room, each room keyed differently and master keyed, unless noted otherwise on drawings. Provide 3 keys per room and 10 building master keys. Provide locks for all teachers' wardrobe units and all other cabinets as indicated on the drawings.
5. Remainder of hardware shall be manufacturer's standard.

2.3. COLORS

A. Finishes: Selected by Architect from manufacturer's full available line.

PART 3 - EXECUTION

3.1. INSPECTION AT JOB SITE

A. Condition of Surfaces: Installer shall inspect the substrates to which the work of this Section adjoins. No work shall be installed until corrections to substrates have been performed by the trades involved.

3.2. INSTALLATION AT JOB SITE

A. To be made under company supervision whenever possible, using skilled labor especially trained for this work. All cabinets to be installed in manner recommended by the manufacturer, including all scribes, moldings and necessary trim. All installations to be complete and in operating condition according to outlined plans and specifications.

B. Comply with manufacturer's instructions for protection, handling and installation of fabricated casework components, with particular attention and care in preservation of applied finishes. Discard or remove and replace damaged members.

3.3. CLEAN UP

A. All cartons and rubbish shall be removed and work area left broom clean.

B. Installer shall remove all pencil marks, adhesive and sawdust resulting from this work.

C. Cleaning of cabinet facings and tops shall be performed by the contractor.

D. Plastic laminate casework shall be cleaned inside and out following procedure recommended by the manufacturer.

END OF SECTION 12 34 00

SECTION 13 34 00

PREFABRICATED ENGINEERED BUILDINGS

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. REFERENCES

A. American Institute of Steel Construction (AISC):

1. Manual of Steel Construction-Allowable Stress Design.

B. American National Standards Institute (ANSI).

C. American Society of Civil Engineers:

1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

D. ASTM International (ASTM):

1. ASTM A36 - Standard Specification for Carbon Structural Steel.
2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM A653/A - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
4. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials
5. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls

E. International Code Council (ICC):

1. ICC/ANSI A117.1 - Accessible and Usable Buildings and Facilities.

1.3. SUBMITTALS

A. Submit under provisions of Division 1.

B. Product Data:

1. Manufacturer's data sheets on each product to be used.
2. Preparation instructions and recommendations.
3. Storage and handling requirements and recommendations.
4. Typical installation methods.

C. Verification Samples: Two representative units of each type, size, pattern and color.

D. Shop Drawings: Include details of materials, construction and finish. Include relationship with adjacent construction.

E. Certificates: Product certificates signed by the manufacturer certifying material compliance with specified performance characteristics and criteria, and physical requirements.

F. Warranty documents specified herein.

1.4. QUALITY CONTROL

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with a minimum five years documented experience.

B. Installer Qualifications: Company specializing in performing Work of this section with minimum two years documented experience with projects of similar scope and complexity.

C. Source Limitations: Provide each type of product from a single manufacturing source to ensure uniformity.

D. Delegated Design: Manufacturer shall provide fully engineered shop and fabrication drawings prepared by a qualified professional.

1.5. PRE-INSTALLATION CONFERENCE

A. Convene a conference approximately two weeks before scheduled commencement of the Work. Attendees shall include Architect, Contractor and trades involved. Agenda shall include schedule, responsibilities, critical path items and approvals.

1.6. DELIVERY, STORAGE, AND HANDLING

A. Store and handle in strict compliance with manufacturer's written instructions and recommendations.

B. Protect from damage due to weather, excessive temperature, and construction operations.

1.7. PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.8. WARRANTY

A. Manufacturer's standard limited warranty unless indicated otherwise.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

A. Basis of Design Manufacturer: Trachte Building Systems 314 Wilburn Road Sun Prairie, WI 53590-1469 www.trachte.com 1-800-356-5824

1. Other acceptable manufacturers include American Metal Buildings, Olympia Steel Buildings or other manufacturers as approved by Architect.

2.2. MODULAR BUILDING SYSTEMS

A. Contractor shall provide prefabricated modular building, foundations and slab as indicated on Drawings.

1. Premanufactured building shall be set on concrete foundation and slab.

2. Dimensions of slab shall be coordinated to match the approved building manufacturer and model, as dimensions and installation conditions may be manufacturer-specific.

B. Basis of Design: Model #4 Micro as manufactured by Trachte Building Systems.

1. Two (2) bays each at 10 feet x 10 feet
2. Eave height 8'-4"

PART 3 - EXECUTION

3.1. EXAMINATION

A. Do not begin installation until substrates have been properly constructed and prepared.

B. Check installed anchor bolts for accuracy. Verify that bearing surfaces are ready to receive the work.

C. Verify the rough-in of required mechanical and electrical services prior to placement of the structure.

D. If substrate preparation is the responsibility of another installer, notify Architect in writing of unsatisfactory preparation before proceeding.

3.2. PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3. INSTALLATION

A. Install in accordance with manufacturer's instructions approved submittals and in proper relationship with adjacent construction.

B. Separate dissimilar materials using nonconductive tape, paint, or other material not visible in finished work.

C. Place on prepared concrete foundations and slabs provided as specified under Section 03 30 00 - Cast-in-Place Concrete.

D. Anchor securely in place, allowing for required movement, including expansion and contraction.

E. Prefabricated Steel Structures:

1. Install on flat level concrete pad per manufacturer's placement drawings. Position units over utility stub-ups. Verify Shelter is level and anchor.
    a. Anchors are supplied on site, by others. Comply with local codes.

F. Connect electrical services as specified in Division 16.

3.4. FIELD QUALITY CONTROL

A. Field Inspection: Coordinate field inspection in accordance with appropriate sections in Division 01.

B. Manufacturer's Services: Coordinate manufacturer's services in accordance with appropriate sections in Division 01.

3.5. CLEANING AND PROTECTION

A. Clean products in accordance with the manufacturers recommendations.

B. Protect installed products until completion of project.

C. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 13 34 00

SECTION 22 05 23.12

BALL VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specification sections "General Conditions to the Construction Contract", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. SUMMARY

A. Section Includes:

1. Bronze ball valves.

1.3. DEFINITIONS

A. CWP: Cold working pressure.

1.4. ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61 Annex G

1.5. DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and soldered ends.
3. Set ball valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

1.6. QUALITY CONTROL

A. Field Quality Control Services including Testing and Inspections are the responsibility of the contractor.

PART 2 - PRODUCTS

2.1. GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.18 for solder-joint connections.

C. NSF Compliance: NSF 61 Annex G for valve materials for potable-water service.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valves in Insulated Piping:

1. Include 2-inch stem extensions.
2. Extended operating handles of non-thermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Memory stops that are fully adjustable after insulation is applied.

2.2. BRONZE BALL VALVES

A. Retain one or more of paragraphs below if bronze ball valves are required. MSS SP-110 covers both brass and bronze, copper-alloy ball valves from NPS 1/4 to NPS 4 (DN 8 to DN 100). See the Evaluations and manufacturers' catalogs before selecting either brass or bronze ball valves or including both.

B. Caution: Two-piece ball valves with a full or regular port are recommended for most services. One-piece ball valves have a reduced port and one fewer leak path. Three-piece ball valves are recommended if disassembly without removing valve from piping is required.

C. Where pressure drop is a concern, use full-port ball valves. For corrosive or high-temperature applications, use stainless-steel-trim ball valves.

D. Bronze Ball Valves, Two-Piece with Full Port, and Bronze or Brass Trim:

1. Description:
    a. Standard: MSS SP-110.

b. CWP Rating: 600 psig

c. Body Design: Two piece.

E. Body Material: Bronze.

a. Ends: Threaded and soldered.

b. Seats: PTFE.

c. Stem: Bronze or brass.

d. Ball: Chrome-plated brass.

e. Port: Full.

PART 3 - EXECUTION

3.1. EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2. VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3. GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

B. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.

3.4. DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Brass ball valve, one piece.
3. Bronze ball valve, one piece with bronze trim.
4. Bronze ball valves, two-piece with regular port and bronze trim.

END OF SECTION 220523.12

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specification sections "General Conditions to the Construction Contract", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. SUMMARY

A. Section Includes:
   1. Metal pipe hangers and supports.

1.3. ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4. QUALITY CONTROL

A. Field Quality Control Services including Testing and Inspections are the responsibility of the contractor.

PART 2 - PRODUCTS

2.1. METAL PIPE HANGERS AND SUPPORTS

A. Copper Pipe and Tube Hangers:
   1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
   2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

B. Hangers & Clamps for PVC Pipe exclusively in the Brine Facility:
   3. Description: MSS SP-58, Types 1 through 58, stainless-steel, factory-fabricated components.
   4. Hanger Rods: Continuous-thread rod, nuts, washers, clamps stanchions, made of Stainless Steel.

2.2. FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used. Stainless Steel fasteners shall be used in the Brine Facility.

2.3. MATERIALS

A. Carbon Steel: ASTM A 1011/A 1011M.

B. Grout: ASTM C 1107/C 1107M, factory-mixed and -packaged, dry, hydraulic-cement, no shrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Non-staining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi 28-day compressive strength.

PART 3 - EXECUTION

3.1. APPLICATION

A. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.2. HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

C. Insulated Piping:

1. Attach clamps and spacers to piping.
    a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
2. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
3. Shield Dimensions for Pipe: Not less than the following:
    a. NPS 1/4 to NPS 3-1/2 : 12 inches long and 0.048 inch thick.
4. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

3.3. ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.4. HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

F. Use thermal hanger-shield inserts for insulated piping and tubing.

G. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 22 07 19

PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.

1.3. ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).

B. Sustainable Design Submittals:

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.

D. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:

1. Preformed Pipe Insulation Materials: 12 inches NPS 2.

1.4. INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

1.5. QUALITY CONTROL

A. Field Quality Control Services including Testing and Inspections are the responsibility of the contractor.

B. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

C. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

D. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6. DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7. COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.8. SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1. INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Fiber-Glass: Inorganic, incombustible, fiber-glass with all-service vapor-barrier jacket.

1. Special-Shaped Insulation: ASTM C 552, Type III.
2. Preformed Pipe Insulation with all-service Jacket: Comply with ASTM C 552, Type II, Class 1.

2.2. ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F

2.3. MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F
3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
4. Color: White.

2.4. SEALANTS

A. Joint Sealants for Cellular-Glass and Phenolic Products:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F \.
4. Color: White or gray.

2.5. TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Width: 3 inches
2. Thickness: 11.5 mils
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

2.6. SECUREMENTS

A. Staples: Outward-clinching insulation staples, nominal 3/4-inch wide, stainless steel or Monel.

PART 3 - EXECUTION

3.1. EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

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

3.2. PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3. GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

L. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

M. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

N. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Cleanouts.

3.4. PENETRATIONS

A. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

C. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5. GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
6. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

3.6. INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

C. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
5. Install insulation to flanges as specified for flange insulation application.

3.7. FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.8. FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9. PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
1. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.10. INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. NPS 1 and Smaller: Insulation shall be[**one of**] the following:
a. Cellular Glass: 1-1/2 inches.

END OF SECTION 220719

SECTION 22 11 16

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. SUMMARY

A. Section Includes:

1. PVC pipe and fittings.
2. Piping joining materials.

B. Related Requirements:

1. Section 221113 "Facility Water Distribution Piping" for water-service piping outside the building from source to the point where water-service piping enters the building.

1.3. ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

1.4. INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

1.5. QUALITY CONTROL

A. Field Quality Control Services including Testing and Inspections are the responsibility of the contractor.

PART 2 - PRODUCTS

2.1. PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Potable-water piping and components shall comply with NSF 14 and NSF 61 Annex G. Plastic piping components shall be marked with "NSF-pw."

C. Comply with NSF 372 for low lead.

2.2. COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.
    1. Full-face or ring type unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

2.3. TRANSITION FITTINGS

A. General Requirements:
    1. Same size as pipes to be joined.
    2. Pressure rating at least equal to pipes to be joined.
    3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

2.4. PVC PIPE AND FITTINGS

A. PVC Pipe: ASTM D 1785, Schedule 40.

B. PVC Socket Fittings: ASTM D 2466 for Schedule 40 Fittings in "PVC

C. PVC Schedule 80 Threaded Fittings: ASTM D 2464.

2.5. PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:
    1. AWWA C110/A21.10, rubber, flat face, 1/8 thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
    2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

F. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

G. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.6. EARTHWORK

A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

2.7. PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install domestic water piping level and plumb.

D. Install piping to permit valve servicing.

E. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

2.8. JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

2.9. HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch

D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch.

E. Support piping and tubing not listed in this article according to MSS SP-58 and manufacturer's written instructions.

2.10. CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.

2.11. IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

2.12. FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:
    a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
    b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
        (1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
        (2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
    c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
    d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
2. Piping Tests:
    a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
    b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.

c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.

d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.

f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

2.13. ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Check plumbing specialties and verify proper settings, adjustments, and operation.

2.14. CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Fill and isolate system according to either of the following:
        (1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
        (2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
    c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    d. Repeat procedures if biological examination shows contamination.
    e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

2.15. PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

2.16. VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller
2. Drain Duty: Hose-end drain valves.

END OF SECTION 221116

SECTION 221313
FACILITY SANITARY SEWERS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions of the Construction Contract”, “Special Conditions”, and “Division 1 - General Requirements” form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Hub-and-spigot, cast-iron soil pipe and fittings.
2. Hubless cast-iron soil pipe and fittings.
3. Nonpressure-type transition couplings.
4. Pressure-type pipe couplings.
5. Expansion joints and deflection fittings.
6. Cleanouts.
7. Encasement for piping.
8. Manholes.
9. Concrete.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For manholes. Include plans, elevations, sections, details, and frames and covers.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings:

1. Show system piping in profile. Draw profiles to horizontal scale of not less than 1 inch equals 50 feet and to vertical scale of not less than 1 inch equals 5 feet. Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.

B. Product Certificates: For each type of pipe and fitting.

C. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PVC PIPE AND FITTINGS

A. PVC Type PSM Sewer Piping:

1. Pipe: ASTM D3034, SDR 35, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D3034, PVC with bell ends.
3. Gaskets: ASTM F477, elastomeric seals.

2.2 NONPRESSURE-TYPE TRANSITION COUPLINGS

A. Comply with ASTM C1173, elastomeric, sleeve-type, reducing or transition coupling; for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and include corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:
1. For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.
2. For Dissimilar Pipes: ASTM D5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings:

1. Description: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Ring-Type, Flexible Couplings:

1. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

E. Nonpressure-Type, Rigid Couplings:

1. Description: ASTM C1461, sleeve-type, reducing- or transition-type mechanical coupling; molded from ASTM C1440, TPE material; with corrosion-resistant-metal tension band and tightening mechanism on each end.

2.3 CLEANOUTS

A. Cast-Iron Cleanouts:

1. Description: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.

2. Top-Loading Classification(s): Light Duty and Heavy Duty.
3. Sewer Pipe Fitting and Riser to Cleanout: ASTM A74, Service class, cast-iron soil pipe and fittings.

2.4 MANHOLES

A. Standard Precast Concrete Manholes:

1. Description: ASTM C478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Diameter: 48 inches minimum unless otherwise indicated.
3. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
4. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section; with separate base slab or base section with integral floor.
5. Riser Sections: 4-inch minimum thickness, of length to provide depth indicated.
6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated; with top of cone of size that matches grade rings.
7. Joint Sealant: ASTM C990, bitumen or butyl rubber.
8. Resilient Pipe Connectors: ASTM C923, cast or fitted into manhole walls, for each pipe connection.
9. Steps: Individual FRP steps or FRP ladder; wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches.
10. Adjusting Rings: Interlocking HDPE rings, with level or sloped edge in thickness and diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
11. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Manhole Frames and Covers:

1. Description: Ferrous; 24-inch ID by 7- to 9-inch riser, with 4-inch-minimum-width flange and 26-inch-diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SANITARY SEWER."
2. Material: ASTM A536, Grade 60-40-18 ductile iron unless otherwise indicated.

2.5 CONCRETE

A. General: Cast-in-place concrete complying with ACI 318, ACI 350, and the following:

1. Cement: ASTM C150/C150M, Type II.
2. Fine Aggregate: ASTM C33/C33M, sand.
3. Coarse Aggregate: ASTM C33/C33M, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A1064/A1064M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A615/A615M, Grade 60 deformed steel.

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.

1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.

a. Invert Slope: 2 percent through manhole.

2. Benches: Concrete, sloped to drain into channel.

a. Slope: 4 percent.

D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A1064/A1064M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A615/A615M, Grade 60 deformed steel.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details to indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.

F. Install gravity-flow, nonpressure, drainage piping according to the following:

1. Install piping pitched down in direction of flow, at minimum slope of 1 percent unless otherwise indicated.
2. Install piping NPS 6 and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
3. Install piping with 36-inch minimum cover.
4. Install PVC Type PSM sewer piping according to ASTM D2321 and ASTM F1668.

G. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure, drainage piping according to the following:
1. Join PVC Type PSM sewer piping according to ASTM D2321 and ASTM D3034 for elastomeric-seal joints or ASTM D3034 for elastomeric-gasket joints.
2. Join dissimilar pipe materials with nonpressure-type, flexible couplings.

B. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use nonpressure flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.

a. Unshielded flexible couplings for pipes of same or slightly different OD.
b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.

3.4 MANHOLE INSTALLATION

A. General: Install manholes complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants according to ASTM C891.

C. Form continuous concrete channels and benches between inlets and outlet.

D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere unless otherwise indicated.

3.5 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

3.6 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts, and use cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
2. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.

B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.7 CONNECTIONS

A. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye fitting plus 6-inch overlap with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes by cutting opening into existing unit large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of, and be flush with, inside wall unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

    a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
    b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

4. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.8 CLOSING ABANDONED SANITARY SEWER SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:

1. Close open ends of piping with at least 8-inch- thick, brick masonry bulkheads.
2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

B. Abandoned Manholes: Excavate around manhole as required and use either procedure below:

1. Remove manhole and close open ends of remaining piping.
2. Remove top of manhole down to at least 36 inches below final grade. Fill to within 12 inches of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.

C. Backfill to grade according to Section 312000 "Earth Moving."

3.9 IDENTIFICATION

A. Comply with requirements in Section 312000 "Earth Moving" for underground utility identification devices. Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.

1. Use warning tape or detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

3.10 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate report for each system inspection.
2. Defects requiring correction include the following:

    a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
    d. Infiltration: Water leakage into piping.
    e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:

    a. Fill sewer piping with water. Test with pressure of at least 10-foot head of water, and maintain such pressure without leakage for at least 15 minutes.
    b. Close openings in system and fill with water.
    c. Purge air and refill with water.
    d. Disconnect water supply.
    e. Test and inspect joints for leaks.

6. Manholes: Perform hydraulic test according to ASTM C969.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

END OF SECTION 221313

SECTION 22 13 16

SANITARY WASTE VENT PIPING

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

B. Section Includes:

1. Hub-and-spigot, cast-iron soil pipe and fittings.
2. Hubless, cast-iron soil pipe and fittings.

C. Related Requirements:

1. Section 221313 "Facility Sanitary Sewers" for sanitary sewerage piping and structures outside the building.
2. Section 221329 "Sanitary Sewerage Pumps" for effluent and sewage pumps.
3. Section 226600 "Chemical-Waste Systems for Laboratory and Healthcare Facilities" for chemical-waste and vent piping systems.

1.2. ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For hubless, single-stack drainage system. Include plans, elevations, sections, and details.

1.3. INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

1.4. QUALITY CONTROL

A. Field Quality Control Services including Testing and Inspections are the responsibility of the contractor.

PART 2 - PRODUCTS

2.1. PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water

2.2. PIPING MATERIALS

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3. HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class(es).

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

1. Grooved-End, Ductile-Iron Fittings: ASTM A 536 ductile-iron castings, with dimensions matching AWWA C110/A 21.10 ductile-iron pipe or AWWA C153/A 21.53 ductile-iron fittings, and complying with AWWA C606 for grooved ends.
2. Grooved Mechanical Couplings for Ductile-Iron Pipe: ASTM F 1476, Type I. Include ferrous housing sections with continuous curved keys; EPDM-rubber center-leg gasket suitable for hot and cold water; and bolts and nuts.

PART 3 - EXECUTION

3.1. EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2. PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.

1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
2. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.

1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
    a. Straight tees, elbows, and crosses may be used on vent lines.
3. Do not change direction of flow more than 90 degrees.
4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
    a. Reducing size of waste piping in direction of flow is prohibited.

K. Lay buried building waste piping beginning at low point of each system.

1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
3. Maintain swab in piping and pull past each joint as completed.

L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Waste: 2 percent downward in direction of flow for piping
2. Horizontal Sanitary Waste Piping: 2 percent downward in direction of flow.
1. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.

N. Install engineered soil and waste and vent piping systems as follows:

1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
2. Hubless, Single-Stack Drainage System: Comply with ASME B16.45 and hubless, single-stack aerator fitting manufacturer's written installation instructions.

3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

O. Install underground, ductile-iron, force-main piping according to AWWA C600.

1. Install buried piping inside building between wall and floor penetrations and connection to sanitary sewer piping outside building with restrained joints.
2. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
3. Install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.

P. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."

1. Install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.

Q. Install force mains at elevations indicated.

R. Plumbing Specialties:

1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
    a. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.
    b. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
2. Install drains in sanitary waste gravity-flow piping.
    a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

S. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

T. Install sleeves for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install sleeve seals for piping penetrations of concrete walls and slabs.

1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

V. Install escutcheons for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3. JOINT CONSTRUCTION

A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.

3.4. VALVE INSTALLATION

A. Comply with requirements in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping" for general-duty valve installation requirements.

3.5. CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect waste and vent piping to the following:

1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.

D. Connect force-main piping to the following:

1. Sanitary Sewer: To exterior force main.
2. Sewage Pump: To sewage pump discharge.

E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

3.6. IDENTIFICATION

A. Identify exposed sanitary waste and vent piping.

B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.7. FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
    a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
    a. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
    a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water
    b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
    c. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
    a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa).
    b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
    c. Air pressure must remain constant without introducing additional air throughout period of inspection.
    d. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.8. CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Repair damage to adjacent materials caused by waste and vent piping installation.

3.9. PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, vent piping 3”; and smaller shall be the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

C. Aboveground, vent piping shall be the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

D. Underground, soil, waste, and vent shall be the following:

1. **S**ervic**e** class, cast-iron soil piping; gaskets**;** and gasketed calking materials**;** and calked joints.

END OF SECTION 221316

SECTION 22 13 19.13

SANITARY DRAINS

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. SUMMARY

A. Section Includes:

1. Floor drains.

1.3. ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4. QUALITY CONTROL

A. Field Quality Control Services including Testing and Inspections are the responsibility of the contractor.

PART 2 - PRODUCTS

2.1. DRAIN ASSEMBLIES

A. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic sanitary piping specialty components.

2.2. FLOOR DRAINS

A. Cast-Iron Floor Drains

1. Standard: ASME A112.6.3
2. Pattern: Floor
3. Body Material: Gray iron
4. Seepage Flange: Required.
5. Anchor Flange: Not required
6. Clamping Device Required.
7. Outlet: Bottom
8. Coating on Interior and Exposed Exterior Surfaces: Not required
9. Sediment Bucket: Not required
10. Top or Strainer Material: Gray iron
11. Top of Body and Strainer Finish: Dura Coat.
12. Top Shape: Round
13. Dimensions of Top or Strainer: 6” O.D. Trap Material: Cast iron

PART 3 - EXECUTION

3.1. INSTALLATION

A. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
3. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.
    a. Maintain integrity of waterproof membranes where penetrated.

3.2. CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Comply with requirements in Section 221319 "Sanitary Waste Piping Specialties" for backwater valves, air admittance devices and miscellaneous sanitary drainage piping specialties.

C. Install piping adjacent to equipment to allow service and maintenance.

3.3. LABELING AND IDENTIFYING

A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4. PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319.13

SECTION 22 13 19

SANITARY WASTE PIPING SPECIALITIES

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. SUMMARY

A. Section Includes:

1. Cleanouts.
2. Miscellaneous sanitary drainage piping specialties.

1.3. DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene.

B. PVC: Polyvinyl chloride.

1.4. CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

1.5. QUALITY CONTROL

A. Field Quality Control Services including Testing and Inspections are the responsibility of the contractor.

PART 2 - PRODUCTS

2.1. ASSEMBLY DESCRIPTIONS

A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.

2.2. CLEANOUTS

A. Cast-Iron Exposed Cleanouts

1. Standard: ASME A112.36.2M.
2. Size: Same as connected drainage piping
3. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
4. Closure: Countersunk
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

PART 3 - EXECUTION

3.1. INSTALLATION

A. Equipment Mounting:
   1. Comply with requirements for vibration-isolation.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
   1. Size same as drainage piping.

C. Assemble open drain fittings and install with top of hub maximum of 1 inch above floor.

D. Install vent caps on each vent pipe passing through roof.

3.2. CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

3.3. FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4. PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

3.5. DEMONSTRATION

A. Engage a factory-authorized service representative to train DGS maintenance personnel to adjust, operate, and maintain FOG disposal systems. Refer to Section 017900 "Demonstration and Training."

END OF SECTION 221319

SECTION 22 33 00

ELECTRIC DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. SUMMARY

A. Section Includes:

1. Commercial, light-duty, storage, electric, domestic-water heaters.

1.3. PERFORMANCE REQUIREMENTS

A. Seismic Performance: Commercial domestic-water heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 7

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified

1.4. ACTION SUBMITTALS

A. Product Data: For each type and size of domestic-water heater indicated, refer to the Contract Drawings that includes the Schedule for Electric Water Heater

B. Shop Drawings:

1. Wiring Diagrams: For power, signal, and control wiring.

1.5. INFORMATIONAL SUBMITTALS

A. Commercial electric, domestic-water heater, from manufacturer.

B. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

C. Source quality-control reports.

D. Field quality-control reports.

E. Warranty: Sample of special warranty.

1.6. CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For electric, domestic-water heaters to include in emergency, operation, and maintenance manuals.

1.7. QUALITY CONTROL

A. Field Quality Control Services including Testing and Inspections are the responsibility of the contractor.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

D. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

E. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects."

1.8. COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.9. WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
    a. Structural failures including storage tank and supports.
    b. Faulty operation of controls.
    c. Deterioration of metals, metal finishes, and other materials beyond normal use.
2. Warranty Periods: From date of Substantial Completion.
    a. Commercial, Electric, Storage, Domestic-Water Heaters:
        (1) Storage Tank: 6 years.
        (2) Controls and Other Components Five years.

PART 2 - PRODUCTS

2.1. COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS

A. Commercial, Electric, Domestic-Water Booster Heaters:

1. Standard: UL 1453.
2. Tank Construction: Corrosion-resistant metal
    a. Tappings: ASME B1.20.1 pipe thread.
    b. Pressure Rating: 150 psig

c. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable-water tank linings, including extending lining material into tappings.

3. Factory-Installed Tank Appurtenances:
   a. Anode Rod: Replaceable magnesium.
   b. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
   c. Insulation: Comply with ASHRAE/IESNA 90.1.
   d. Jacket: Rectangular shaped, with stainless-steel front panel, unless otherwise indicated.
   e. Heating Elements: Electric, screw-in or bolt-on immersion type
   f. Temperature Control: Adjustable thermostat, to setting of at least 180 deg
   g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
   h. Relief Valve: ASME rated and stamped for combination temperature-and-pressure relief valve. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.
   i. Gages: Combination temperature-and-pressure type or separate thermometer and pressure gage.
4. Capacity: 6 gal.
5. Recovery: 8 gph at 80 deg F
6. Temperature Setting: 120 deg F
7. Power Demand: 1.6 KW
8. Heating Elements:
   a. Number of Elements: One
   b. Kilowatts Each Element: 1.65 KW
   c. Number of Stages: One
   d. Volts: 120
   e. Phases: Single
   f. Hertz: 60.
   g. Full-Load Amperes: 16
   h. Minimum Circuit Ampacity: 16
   i. Maximum Overcurrent Protection: 20

2.2. DOMESTIC-WATER HEATER ACCESSORIES

A. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.

B. Pressure-Reducing Valves: ASSE 1003 for water. Set at 25-psig maximum outlet pressure unless otherwise indicated.

C. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.

D. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than domestic-water heater working-pressure rating.

E. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.

F. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.

2.3. SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test domestic-water heaters to minimum of one and one-half times pressure rating before shipment.

C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1. DOMESTIC-WATER HEATER INSTALLATION

A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in Section 033000 "Cast-in-Place Concrete

1. Maintain manufacturer's recommended clearances.
2. Arrange units so controls and devices that require servicing are accessible.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Anchor domestic-water heaters to substrate.

B. Fill electric, domestic-water heaters with water.

C. Charge domestic-water compression tanks with air.

3.2. CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3. IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4. FIELD QUALITY CONTROL

A. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
   2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

C. Prepare test and inspection reports.

3.5. DEMONSTRATION

A. [Owner's maintenance personnel to adjust, operate, and maintain electric, domestic-water heaters.

END OF SECTION 223300

SECTION 22 42 13.13

COMMERCIAL WATER CLOSETS

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. SUMMARY

A. Section Includes:

1. Water closets.
2. Toilet seats.

1.3. DEFINITIONS

A. Effective Flush Volume: Average of two reduced flushes and one full flush per fixture.

1.4. ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water closets.

1.5. CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flush tank to include in operation and maintenance manuals.

1.6. MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.

1. Flushometer-Valve Repair Kits:

1.7. QUALITY CONTROL

A. Field Quality Control Services including Testing and Inspections are the responsibility of the contractor.

PART 2 - PRODUCTS

2.1. FLOOR-MOUNTED, BOTTOM-OUTLET, TANK TYPE WATER CLOSETS

A. Water Closets Floor mounted, bottom outlet, Tank-type, P-1A.

1. Tank, Bowl Mfr.: Refer to Plumbing Fixture Schedule on Dwgs

a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
b. Material: Vitreous china.
c. Style: Flush Tank.
d. Height: ADA compliant
e. Rim Contour: Elongated.
f. Water Consumption: 1.28 gal per flush.
g. Color: White

2. Bowl-to-Drain Connecting Fitting: ASME A112..19.2-2008.

2.2. TOILET SEATS

A. Toilet Seats:

1. Material: Plastic.
2. Type: Commercial Standard
3. Shape: Elongated rim, open front
4. Hinge Material: Solid Plastic.
5. Seat Cover: Not Required
6. Color: White

PART 3 - EXECUTION

3.1. EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.

B. Examine walls and floors for suitable conditions where water closets will be installed.

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

3.2. INSTALLATION

A. Water-Closet Installation:

1. Install level and plumb according to roughing-in drawings.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.

B. Install toilet seats on water closets.

C. Wall Flange and Escutcheon Installation:

3. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
4. Install deep-pattern escutcheons if required to conceal protruding fittings.
5. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

D. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3. CONNECTIONS

A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.4. ADJUSTING

A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.

3.5. CLEANING AND PROTECTION

A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed water closets and fittings.

C. Do not allow use of water closets for temporary facilities unless approved in writing by DGS.

END OF SECTION 224213.13

SECTION 22 42 13.16

COMMERCIAL URINALS

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. SUMMARY

A. Section Includes:

1. Urinals.
2. Flushometer valves.
3. Supports.

B. Related Requirements:

1. Section 224600 "Security Plumbing Fixtures" for security urinals.

1.3. ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for urinals.

1.4. CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flushometer valves **and electronic sensors** to include in operation and maintenance manuals.

1.5. MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.

1. Flushometer-Valve Repair Kits: Equal to 2 of each type installed.

1.6. QUALITY CONTROL

A. Field Quality Control Services including Testing and Inspections are the responsibility of the contractor.

PART 2 - PRODUCTS

2.1. WALL-HUNG URINALS

A. Urinals P-3A: Wall hung, bottom outlet.

1. Fixture:
    a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
    b. Material: Vitreous china.
    c. Strainer or Trapway: Manufacturer's standard strainer
    d. Water Consumption: Water saving.
    e. Spud Size and Location: NPS ¾" top spud.
    f. Outlet Size and Location: NPS 1-1/2" bottom.
    g. Color: White
2. Flushometer Valve: Manual Operated Flush Valve Part No. 6045.101.002
3. Waste Fitting:
    a. Standard: ASME A112.19.2/CSA B45.1for coupling.
    b. Size: NPS 1-1/2"
4. Support: Urinal Carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture
5. Urinal Mounting Height: Standard.

2.2. URINAL FLUSHOMETER VALVES

A. Lever-Handle, Diaphragm Flushometer Valves
1. Standard: ASSE 1037.
2. Minimum Pressure Rating: 125 psig
3. Features: Include integral check stop and backflow-prevention device.
4. Material: Brass body with corrosion-resistant components.
5. Exposed Flushometer-Valve Finish: Chrome plated.
6. Panel Finish: Chrome plated or stainless steel.
7. Style: Exposed
8. Consumption: 1.0 gal per flush.
9. Minimum Inlet: NPS 3/4"
10. Minimum Outlet: NPS 3/4

2.3. SUPPORTS

A. Type I Urinal Carrier:
1. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.1. EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before urinal installation.

B. Examine walls and floors for suitable conditions where urinals will be installed.

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

3.2. INSTALLATION

A. Urinal Installation:

1. Install urinals level and plumb according to roughing-in drawings.

B. Support Installation:

1. Install supports, affixed to building substrate, for wall-hung urinals.

C. Flushometer-Valve Installation:

1. Install flushometer-valve water-supply fitting on each supply to each urinal.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible urinals with handle mounted on open side of compartment.

D. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations.

E. Joint Sealing:

1. Seal joints between urinals and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to urinal color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3. CONNECTIONS

A. Connect urinals with water supplies and soil, waste, and vent piping. Use size fittings required to match urinals.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to urinals, allow space for service and maintenance.

3.4. ADJUSTING

A. Operate and adjust urinals and controls. Replace damaged and malfunctioning urinals, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

3.5. CLEANING AND PROTECTION

A. Clean urinals and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed urinals and fittings.

C. Do not allow use of urinals for temporary facilities unless approved in writing by DGS.

END OF SECTION 224213.16

SECTION 22 42 16.13

COMMERCIAL LAVATORIES

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. SUMMARY

A. Section Includes:

1. Lavatories.
2. Faucets.
3. Supply fittings.
4. Waste fittings.
5. Supports.

1.3. ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for lavatories.

1.4. INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.5. CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.

1.6. MAINTENANCE MATERIAL SUBMITTALS

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

1. Faucet Washers and O-Rings: Equal to 2 of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 2 each type and size installed.

1.7. QUALITY CONTROL

A. Field Quality Control Services including Testing and Inspections are the responsibility of the contractor.

PART 2 - PRODUCTS

2.1. ENAMELED, CAST-IRON, WALL-MOUNTED LAVATORIES

A. Lavatory Rectangular, enameled, cast iron, wall mounted.

1. Fixture:
    a. Standard: ASME A112.19.1/CSA B45.1.
    b. Type: Straight-front apron with straight back.
    c. Nominal Size: Rectangular, 19 by 17 inches
    d. Faucet-Hole Punching: Three holes**,** 4-inch centers.
    e. Faucet-Hole Location: Top.
    f. Color: White
    g. Mounting Material: Wall bracket.
2. Faucet: Insert lavatory faucet designation from "Solid-Brass, Manually Operated Faucets.
3. Support: Type III lavatory carrier.
4. Lavatory Mounting Height: Handicapped/elderly according to ICC A117.1.

2.2. SOLID-BRASS, MANUALLY OPERATED FAUCETS

A. NSF Standard: Comply with NSF 372 for faucet materials that will be in contact with potable water.

B. Lavatory Faucets Manual-type, single-control mixing commercial, solid-brass valve.

1. Standard: ASME A112.18.1/CSA B125.1.
2. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture single hole punching; coordinate outlet with spout and fixture receptor.
3. Body Type: Centerset
4. Body Material: Commercial, solid brass.
5. Finish: Polished chrome plate
6. Maximum Flow Rate: 0.5 gpm
7. Maximum Flow: 0.25 gal.
8. Mounting Type: Deck, concealed
9. Valve Handle(s): Single lever
10. Spout: Rigid
11. Spout Outlet: Aerator
12. Operation: Compression, manual

2.3. SUPPLY FITTINGS

A. NSF Standard: Comply with NSF 372 for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Wheel handle

F. Standard: ASME A112.18.2/CSA B125.2.

G. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.

H. Trap:

1. Size: NPS 1-1/4 by NPS 1-1/4
2. Material: Chrome-plated two-piece, cast-brass trap and ground-joint swivel elbow with 0.032-inch- thick brass tube to wall and chrome-plated, brass or steel wall flange.

2.4. SUPPORTS

A. Type II Lavatory Carrier:

1. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.1. EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.

B. Examine walls for suitable conditions where lavatories will be installed.

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

3.2. INSTALLATION

A. Install lavatories level and plumb according to roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-mounted lavatories.

C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.

D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

E. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3. CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4. ADJUSTING

A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.5. CLEANING AND PROTECTION

A. After completing installation of lavatories, inspect and repair damaged finishes.

B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed lavatories and fittings.

D. Do not allow use of lavatories for temporary facilities unless approved in writing by DGS.

END OF SECTION 224216.13

SECTION 23 01 30.51

HVAC AIR DISTIBUTION SYSTEM CLEANING

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. SUMMARY

A. Section includes cleaning HVAC air-distribution equipment, ducts, plenums, and system components.

1.3. DEFINITIONS

A. ASCS: Air systems cleaning specialist.

B. NADCA: National Air Duct Cleaners Association.

1.4. INFORMATIONAL SUBMITTALS

A. Qualification Data: For an ASCS.

B. Strategies and procedures plan.

C. Cleanliness verification report.

1.5. QUALITY CONTROL

A. Field Quality Control Services including Testing and Inspections are the responsibility of the contractor.

B. ASCS Qualifications: A certified member of NADCA

3. Certification: Employ an ASCS certified by NADCA on a full-time basis
4. Supervisor Qualifications: Certified **as** an ASCS by NADCA

C. UL Compliance: Comply with UL 181 and UL 181A for fibrous-glass ducts.

D. Cleaning Conference: Conduct conference at Project site

3. Review methods and procedures related to HVAC air-distribution system cleaning including, but not limited to, review of the cleaning strategies and procedures plan.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1. EXAMINATION

A. Examine HVAC air-distribution equipment, ducts, plenums, and system components to determine appropriate methods, tools, and equipment required for performance of the Work.

B. Perform "Project Evaluation and Recommendation" according to NADCA ACR 2006.

C. Prepare written report listing conditions detrimental to performance of the Work.

D. Proceed with work only after unsatisfactory conditions have been corrected.

3.2. PREPARATION

A. Prepare a written plan that includes strategies and step-by-step procedures. At a minimum, include the following:

3. Supervisor contact information.
4. Work schedule including location, times, and impact on occupied areas.
5. Methods and materials planned for each HVAC component type.
6. Required support from other trades.
7. Equipment and material storage requirements.
8. Exhaust equipment setup locations.

B. Use the existing service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry and for inspection.

C. Comply with NADCA ACR 2006, "Guidelines for Constructing Service Openings in HVAC Systems" Section.

3.3. CLEANING

A. Comply with NADCA ACR 2006.

B. Remove visible surface contaminants and deposits from within the HVAC system.

C. Systems and Components to Be Cleaned:

3. Air devices for supply and return air.
4. Air-terminal units.
5. Ductwork:

a. Supply-air ducts, including turning vanes to the air-handling unit.
b. Return-air ducts to the air-handling unit.
c. Exhaust-air ducts.

6. Air-Handling Units:

    a. Interior surfaces of the unit casing.
    b. Coil surfaces compartment.
    c. Condensate drain pans.
    d. Fans, fan blades, and fan housings.

7. Filters and filter housings.

D. Collect debris removed during cleaning. Ensure that debris is not dispersed outside the HVAC system during the cleaning process.

E. Particulate Collection:

3. For particulate collection equipment, include adequate filtration to contain debris removed. Locate equipment downwind and away from all air intakes and other points of entry into the building.
4. HEPA filtration with 99.97 percent collection efficiency for particles sized 0.3 micrometer or larger shall be used where the particulate collection equipment is exhausting inside the building,

F. Control odors and mist vapors during the cleaning and restoration process.

G. Mark the position of manual volume dampers and air-directional mechanical devices inside the system prior to cleaning. Restore them to their marked position on completion of cleaning.

H. System components shall be cleaned so that all HVAC system components are visibly clean. On completion, all components must be returned to those settings recorded just prior to cleaning operations.

I. Clean all air-distribution devices, registers, grilles, and diffusers.

J. Clean visible surface contamination deposits according to NADCA ACR 2006 and the following:

3. Clean air-handling units, airstream surfaces, components, condensate collectors, and drains.
4. Ensure that a suitable operative drainage system is in place prior to beginning washdown procedures.
5. Clean evaporator coils, reheat coils, and other airstream components.

K. Duct Systems:

3. Create service openings in the HVAC system as necessary to accommodate cleaning.
4. Mechanically clean duct systems specified to remove all visible contaminants so that the systems are capable of passing the HVAC System Cleanliness Tests (see NADCA ACR 2006).

L. Debris removed from the HVAC system shall be disposed of according to applicable Federal, state, and local requirements.

M. Mechanical Cleaning Methodology:

3. Source-Removal Cleaning Methods: The HVAC system shall be cleaned using source-removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and to safely remove these contaminants from the facility. No cleaning method, or combination of methods, shall be used that could potentially damage components of the HVAC system or negatively alter the integrity of the system.

    a. Use continuously operating vacuum-collection devices to keep each section being cleaned under negative pressure.
    b. Cleaning methods that require mechanical agitation devices to dislodge debris that is adhered to interior surfaces of HVAC system components shall be equipped to safely remove these devices. Cleaning methods shall not damage the integrity of HVAC system components or damage porous surface materials such as duct and plenum liners.

4. Cleaning Mineral-Fiber Insulation Components:

    a. Fibrous-glass thermal or acoustical insulation elements present in equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment while the HVAC system is under constant negative pressure and shall not be permitted to get wet according to NADCA ACR 2006.
    b. Cleaning methods used shall not cause damage to fibrous-glass components and will render the system capable of passing the HVAC System Cleanliness Tests (see NADCA ACR 2006).
    c. Fibrous materials that become wet shall be discarded and replaced.

N. Coil Cleaning:

3. Measure static-pressure differential across each coil.
4. See NADCA ACR 2006, "Coil Surface Cleaning" Section. Type 1, or Type 1 and Type 2, cleaning methods shall be used to render the coil visibly clean and capable of passing Coil Cleaning Verification (see applicable NADCA ACR 2006).
5. Coil drain pans shall be subject to NADCA ACR 2006, "Non-Porous Surfaces Cleaning Verification." Ensure that condensate drain pans are operational.
6. Electric-resistance coils shall be de-energized, locked out, and tagged before cleaning.
7. Cleaning methods shall not cause any appreciable damage to, cause displacement of, inhibit heat transfer, or cause erosion of the coil surface or fins, and shall comply with coil manufacturer's written recommendations when available.
8. Rinse thoroughly with clean water to remove any latent residues.

O. Antimicrobial Agents and Coatings:

3. Apply antimicrobial agents and coatings if active fungal growth is reasonably suspected or where unacceptable levels of fungal contamination have been verified. Apply antimicrobial agents and coatings according to manufacturer's written recommendations and EPA registration listing after the removal of surface deposits and debris.
4. When used, antimicrobial treatments and coatings shall be applied after the system is rendered clean.
5. Apply antimicrobial agents and coatings directly onto surfaces of interior ductwork.
6. Sanitizing agent products shall be registered by the EPA as specifically intended for use in HVAC systems and ductwork.

3.4. CLEANLINESS VERIFICATION

A. Verify cleanliness according to NADCA ACR 2006, "Verification of HVAC System Cleanliness" Section.

B. Verify HVAC system cleanliness after mechanical cleaning and before applying any treatment or introducing any treatment-related substance to the HVAC system, including biocidal agents and coatings.

C. Perform visual inspection for cleanliness. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean. If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection for cleanliness.

D. Additional Verification:

3. Perform surface comparison testing or NADCA vacuum test.
4. Conduct NADCA vacuum gravimetric test analysis for nonporous surfaces.

E. Verification of Coil Cleaning:

3. Measure static-pressure differential across each coil.
4. Coil will be considered clean if cleaning restored the coil static-pressure differential within 10 percent of inches wg, the differential measured when the coil was first installed.
5. Coil will be considered clean if the coil is free of foreign matter and chemical residue, based on a thorough visual inspection.

F. Prepare a written cleanliness verification report. At a minimum, include the following:

3. Written documentation of the success of the cleaning.
4. Site inspection reports, initialed by supervisor, including notation on areas of inspection, as verified through visual inspection.
5. Surface comparison test results if required.
6. Gravimetric analysis (nonporous surfaces only).
7. System areas found to be damaged.

G. Photographic Documentation: Comply with requirements in Section 013233 "Photographic Documentation."

3.5. RESTORATION

A. Restore and repair HVAC air-distribution equipment, ducts, plenums, and components according to NADCA ACR 2006, "Restoration and Repair of Mechanical Systems" Section.

B. Restore service openings capable of future reopening. Comply with requirements in Section 233113 "Metal Ducts." Include location of service openings in Project closeout report.

C. Replace fibrous-glass materials that cannot be restored by cleaning or resurfacing. Comply with requirements in Section 233113 "Metal Ducts" and Section 233116 "Nonmetal Ducts."

D. Replace damaged insulation according to Section 230713 "Duct Insulation."

E. Ensure that closures do not hinder or alter airflow.

F. New closure materials, including insulation, shall match opened materials and shall have removable closure panels fitted with gaskets and fasteners.

G. Reseal fibrous-glass ducts. Comply with requirements in Section 233116 "Nonmetal Ducts."

END OF SECTION 230130.51

SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. SUMMARY

A. Section includes general requirements for single-phase general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3. COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Torque, speed, and horsepower requirements of the load.
2. Ratings and characteristics of supply circuit and required control sequence.
3. Ambient and environmental conditions of installation location.

1.4. QUALITY CONTROL

A. Field Quality Control Services including Testing and Inspections are the responsibility of the contractor.

PART 2 - PRODUCTS

2.1. GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

B. Comply with IEEE 841 for severe-duty motors.

2.2. MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3. SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
   1. Permanent-split capacitor.
   2. Split phase.
   3. Capacitor start, capacitor run.

B. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

C. Motors 1/20 HP and Smaller: Shaded-pole type.

D. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

END OF SECTION 230513

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Fastener systems.

B. Related Sections:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

1.3. DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4. PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.5. ACTION SUBMITTALS

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

1.6. QUALITY CONTROL

A. Field Quality Control Services including Testing and Inspections are the responsibility of the contractor.

PART 2 - PRODUCTS

2.1. METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.

3. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.2. FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.3. EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.4. MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi 28-day compressive strength.

PART 3 - EXECUTION

3.1. HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

C. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.

D. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

E. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

F. Install hangers and supports to allow controlled thermal of piping systems.

G. Install lateral bracing with pipe hangers and supports to prevent swaying.

H. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

3.2. ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches

3.3. PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

3.4. HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and attachments for general service applications.

F. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

G. Specified in piping system Sections.

H. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

END OF SECTION 230529

SECTION 23-05 93

TESTING ADJUSTING & BALANCING FOR HVAC

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. SUMMARY

A. Section Includes:

1. Balancing Air Systems:
    a. Constant-volume air systems.
2. Testing, adjusting, and balancing existing systems and equipment.
3. Sound tests.
4. Duct leakage tests.

1.3. DEFINITIONS

A. AABC: Associated Air Balance Council.

1.4. INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. System Readiness Checklists: Within 30 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.

E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

F. Certified TAB reports.

G. Sample report forms.

H. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.

5. Dates of calibration.

1.5. QUALITY CONTROL

A. Field Quality Control Services including Testing and Inspections are the responsibility of the contractor.

B. TAB Specialists Qualifications: Certified by AABC

1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
2. TAB Technician: Employee of the TAB specialist and certified by AABC as a TAB technician.

C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

E. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.6. FIELD CONDITIONS

A. Full DGS Occupancy: DGS will occupy the site and existing building during entire TAB period. Cooperate with DGS during TAB operations to minimize conflicts with DGS's operations.

PART 2 - (NOT APPLICABLE)

PART 3 - EXECUTION

3.1. 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 installed systems for balancing devices, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

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. 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.

3.2. PREPARATION

A. Prepare a TAB plan that includes the following:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Airside:
    a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
    b. Duct systems are complete with terminals installed.
    c. Clean filters are installed.
    d. Fans are operating, free of vibration, and rotating in correct direction.
    e. Suitable access to balancing devices and equipment is provided.

3.3. GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP)] units.

3.4. GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

D. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

F. Verify that motor starters are equipped with properly sized thermal protection.

G. Check dampers for proper position to achieve desired airflow path.

H. Check for airflow blockages.

I. Check condensate drains for proper connections and functioning.

J. Check for proper sealing of air-handling-unit components.

K. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.5. PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.
    a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
    c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
    d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
2. Measure fan static pressures as follows:
    a. Measure static pressure directly at the fan outlet or through the flexible connection.
    b. Measure static pressure across each component that makes up the air-handling system.
    c. Report artificial loading of filters at the time static pressures are measured.

3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
4. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.

1. Measure airflow of submain and branch ducts.
2. Adjust submain and branch duct volume dampers for specified airflow.
3. Re-measure each submain and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
2. Measure inlets and outlets airflow.
3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
4. Mark all final settings.
5. Measure and record all operating data.
6. Record final fan-performance data.

3.6. PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record fan and motor operating data.

3.7. DUCT LEAKAGE TESTS

A. Witness the duct pressure testing performed by Installer.

B. Verify that proper test methods are used and that leakage rates are within specified tolerances.

C. Report deficiencies observed.

3.8. CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:

1. Verify temperature control system is operating within the design limitations.

3.9. PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record the operating speed, airflow, and static pressure of each fan.
1. Measure motor voltage and amperage. Compare the values to motor nameplate information.
2. Check the refrigerant charge.
3. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:

1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
3. If calculations increase or decrease the airflow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
4. Balance each air outlet.

3.10. TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans Plus or minus 10 percent
2. Air Outlets and Inlets: Plus or minus 10 percent

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.11. PROGRESS REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems balancing devices. Recommend changes and additions to systems balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

3.12. FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Fan curves.
2. Manufacturers' test data.
3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:
    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:

a. Settings for outdoor-, return-, and exhaust-air dampers.
b. Conditions of filters.
c. Cooling coil, wet- and dry-bulb conditions.
d. Fan drive settings including settings and percentage of maximum pitch diameter.
e. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Duct, outlet, and inlet sizes.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
a. Unit identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Unit arrangement and class.
g. Discharge arrangement.
h. Sheave make, size in inches and bore.
i. Center-to-center dimensions of sheave and amount of adjustments in inches
j. Number, make, and size of belts.
k. Number, type, and size of filters.
2. Motor Data:
a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches and bore.
f. Center-to-center dimensions of sheave and amount of adjustments in inches.

F. Apparatus-Coil Test Reports:
1. Coil Data:
a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch o.c.
f. Make and model number.

g. Face area in sq. ft.
h. Tube size in NPS
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):
a. Airflow rate in cfm
b. Average face velocity in fpm
c. Air pressure drop in inches wg.
d. Outdoor-air, wet- and dry-bulb temperatures in deg F
e. Return-air, wet- and dry-bulb temperatures in deg F
f. Entering-air, wet- and dry-bulb temperatures in deg F
g. Leaving-air, wet- and dry-bulb temperatures in deg F
h. Refrigerant expansion valve and refrigerant types.
i. Refrigerant suction pressure in psig
j. Refrigerant suction temperature in deg F.

G. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
1. Unit Data:
a. System identification.
b. Location.
c. Coil identification.
d. Capacity in Btu/h
e. Number of stages.
f. Connected volts, phase, and hertz.
g. Rated amperage.
h. Airflow rate in cfm
i. Face area in sq. ft
(1) Minimum face velocity in fpm

2. Test Data (Indicated and Actual Values):
a. Heat output in Btu/h
b. Airflow rate in cfm
c. Air velocity in fpm
d. Entering-air temperature in deg F
e. Leaving-air temperature in deg F .
f. Voltage at each connection.
g. Amperage for each phase.

H. Fan Test Reports: For supply, return, and exhaust fans, include the following:
1. Fan Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.

2. Motor Data:
   a. Motor make, and frame type and size.
   b. Horsepower and rpm.
   c. Volts, phase, and hertz.
   d. Full-load amperage and service factor.
   e. Sheave make, size in inches and bore.
   f. Center-to-center dimensions of sheave, and amount of adjustments in inches
   g. Number, make, and size of belts.
3. Test Data (Indicated and Actual Values):
   a. Total airflow rate in cfm
   b. Total system static pressure in inches wg
   c. Fan rpm.
   d. Discharge static pressure in inches wg
   e. Suction static pressure in inches wg

I. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:
   a. System and air-handling-unit number.
   b. Location and zone.
   c. Traverse air temperature in deg.
   d. Duct static pressure in inches wg
   e. Duct size in inches.
   f. Duct area in sq. ft. .
   g. Indicated airflow rate in cfm
   h. Indicated velocity in fpm
   i. Actual airflow rate in cfm
   j. Actual average velocity in fpm.
   k. Barometric pressure in psig.

3.13. VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Construction Manager

B. Construction Manager shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

E. If TAB work fails, proceed as follows:

1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, DGS may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
3. If the second verification also fails, design professional may contact AABC Headquarters regarding the AABC National Performance Guaranty.

F. Prepare test and inspection reports.

3.14. ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 23 07 13

DUCT INSULATION

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. SUMMARY

A. Section includes insulating the following duct services:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.

1.3. ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

1.4. INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.5. QUALITY CONTROL

A. Field Quality Control Services including Testing and Inspections are the responsibility of the contractor.

B. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

C. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6. DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7. COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.8. SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1. INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

D. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.

E. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.

2.2. ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

2.3. MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

2.4. SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F
4. Color: Aluminum.

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

2.5. FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

2.6. TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Width: 3 inches.
2. Thickness: 11.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength:40 lbf/ inch in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Width: 3 inches
2. Thickness: 6.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.

5. Tensile Strength: 40 lbf/inch in width.
6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

PART 3 - EXECUTION

3.1. EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

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

3.2. PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3. GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

L. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

M. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4. FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.5. DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in unconditioned space.

3.6. INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, rectangular, supply-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2-1/2 inches nominal density.

B. Concealed, rectangular, return-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2-1/2 inches nominal density.

C. Concealed, rectangular, outdoor-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2-1/2 inches nominal density.

END OF SECTION 230713

SECTION 23 31 13

METAL DUCTS

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Sealant and gaskets.
3. Hangers and supports.

B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3. PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" Retain one of three subparagraphs below if retaining "SMACNA's 'Seismic Restraint Manual: Guidelines for Mechanical Systems'" option in paragraph above. If using other seismic design criteria, delete three subparagraphs below.

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4. ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.

2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.

1.5. INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.
    f. Perimeter moldings.

1.6. QUALITY CONTROL

A. Field Quality Control Services including Testing and Inspections are the responsibility of the contractor.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1. SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2. SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

2.3. HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

PART 3 - EXECUTION

3.1. DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install ducts with fewest possible joints.

D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

H. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches

I. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.

3.2. INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3. DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.4. HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, " Hangers Exposed to View: Threaded rod and angle or channel supports.

C. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5. CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6. PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.7. FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
3. Test for leaks before applying external insulation.
4. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
5. Give seven days' advance notice for testing.

C. Duct system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.8. START UP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.9. DUCT SCHEDULE

A. Supply Ducts:

1. Ducts Connected to Fan Coil Units
   a. Pressure Class: Positive 1-inch wg
   b. Minimum SMACNA Seal Class: A
   c. SMACNA Leakage Class for Rectangular: 12.

B. Return Ducts:

1. Ducts Connected to Fan Coil Units
   a. Pressure Class: Positive or negative 1-inch wg
   b. Minimum SMACNA Seal Class: A

C. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
   a. Pressure Class: Negative 1-inch wg
   b. SMACNA Leakage Class for Rectangular: 12

D. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
   a. Velocity 1000 fpm or Lower:
      (1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
      (2) Mitered Type RE 4 without vanes.
2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.

b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.

E. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

a. Rectangular Main to Rectangular Branch: 45-degree entry.

b. Rectangular Main to Round Branch: Spin in.

END OF SECTION 233113

SECTION 23 33 00

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Turning vanes.
4. Flexible connectors.
5. Duct accessory hardware.

B. Related Requirements:

1. Section 233346 "Flexible Ducts" for insulated and non-insulated flexible ducts.

1.3. ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
   a. Manual volume damper installations.

1.4. INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

B. Source quality-control reports.

1.5. CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.6. MAINTENANCE MATERIAL SUBMITTALS

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

1.7. QUALITY CONTROL

A. Field Quality Control Services including Testing and Inspections are the responsibility of the contractor.

PART 2 - PRODUCTS

2.1. ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2. MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60
2. Exposed-Surface Finish: Mill phosphatized.

2.3. BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Description: Gravity balanced.

B. Maximum Air Velocity:1000 fpm

C. Maximum System Pressure: 1-inch wg

D. Frame: Hat-shaped, 0.05-inch thick, galvanized sheet steel

E. Blades: Multiple single-piece blades, center pivoted 6-inch width, 0.025-inch- thick, Blade Action: Parallel.

F. Blade Seals: Felt

G. Blade Axles:

1. Material: Galvanized steel
2. Diameter: 0.20 inch

H. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.

2.4. MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Standard leakage rating, with linkage outside airstream.
2. Suitable for horizontal or vertical applications.
3. Frames:
    a. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel
    b. Mitered and welded corners.
    c. Flanges for attaching to walls and flangeless frames for installing in ducts.
4. Blades:
    a. Multiple or single blade.
    b. Parallel- or opposed-blade design.
    c. Stiffen damper blades for stability.
    d. Galvanized -steel, 0.064 inch thick.

2.5. TURNING VANES

A. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

3. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

B. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

D. Vane Construction: Single

E. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.6. FLEXIBLE CONNECTORS

A. Materials: Flame-retardant or noncombustible fabrics.

B. Coatings and Adhesives: Comply with UL 181, Class 1.

C. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch- (thick, galvanized sheet steel

D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd.
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F

2.7. DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1. INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.

D. Set dampers to fully open position before testing, adjusting, and balancing.

E. Install test holes at fan inlets and outlets and elsewhere as indicated.

F. Install flexible connectors to connect ducts to equipment.

G. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.

H. Connect diffusers or light troffer boots to ducts directly.

I. Connect flexible ducts to metal ducts with liquid adhesive plus tape

J. Install duct test holes where required for testing and balancing purposes.

K. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2. FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.

3. Inspect turning vanes for proper and secure installation.

END OF SECTION 233300

SECTION 23 34 23

HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections "General Conditions to the Construction Contract", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. SUMMARY

A. Section Includes:
   1. Ceiling-mounted ventilators.

1.3. PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on sea level.

B. Operating Limits: Classify according to AMCA 99.

1.4. ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:
   1. Certified fan performance curves with system operating conditions indicated.
   2. Certified fan sound-power ratings.
   3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
   4. Material thickness and finishes, including color charts.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For unit hangars and supports 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. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

1.5. INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

3. Ceiling suspension assembly members.
1. Size and location of initial access modules for acoustical tile.
2. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

B. Field quality-control reports.

1.6. CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.7. MAINTENANCE MATERIAL SUBMITTALS

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

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

D. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

1.8. COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate sizes and locations of concrete bases with actual equipment provided.

C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.9. QUALITY CONTROL

A. Field Quality Control Services including Testing and Inspections are the responsibility of the contractor.

PART 2 - PRODUCTS

2.1. CEILING-MOUNTED VENTILATORS

A. Housing: Steel, lined with acoustical insulation.

B. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.

C. Grille: Plastic louvered grille with flange on intake and thumbscrew attachment to fan housing.

D. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

E. Accessories:

1. Manual Starter Switch: Single-pole rocker switch assembly with cover.
2. Isolation: Rubber-in-shear vibration isolators.
3. Manufacturer's standard wall cap and transition fittings.

F. Capacities and Characteristics:

1. Airflow: 80 cfm.
2. External Static Pressure: 0.15 inches wg
3. Motor Size: 21 W.
4. Motor rpm: 700.
5. Electrical Characteristics: Volts: 120 V.

2.2. MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

B. Enclosure Type: Totally enclosed, fan cooled.

2.3. SOURCE QUALITY CONTROL

A. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.1. INSTALLATION

A. Install power ventilators level and plumb.

B. Equipment Mounting:

1. Install power ventilators above ceiling.
2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

C. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

D. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2. CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3. FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

3. Verify that shipping, blocking, and bracing are removed.
4. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
5. Verify that cleaning and adjusting are complete.
6. Remove and replace malfunctioning units and retest as specified above.

C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Prepare test and inspection reports.

3.4. ADJUSTING

A. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

B. Replace fan and motor pulleys as required to achieve design airflow.

END OF SECTION 233423

SECTION 23 37 13.23

REGISTERS AND GRILLES

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. SUMMARY

A. Section Includes:

3. Adjustable blade face registers.
4. Fixed face grilles.

B. Related Requirements:

3. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to registers and grilles.

1.3. ACTION SUBMITTALS

A. Product Data: For each type of product.

3. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
4. Register and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

1.4. INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

3. Ceiling suspension assembly members.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

B. Source quality-control reports.

1.5. QUALITY CONTROL

A. Field Quality Control Services including Testing and Inspections are the responsibility of the contractor.

PART 2 - PRODUCTS

2.1. REGISTERS

A. Adjustable Blade Face Register

3. Material: Steel

4. Finish: Baked enamel, white
5. Face Blade Arrangement: Horizontal
6. Core Construction: Integral
7. Frame: 1-1/4 inches.
8. Mounting: Countersunk screw
9. Damper Type: Multishutter

2.2. GRILLES

A. Fixed Face Grille

3. Material: Steel
4. Finish: Baked enamel, white
5. Face Blade Arrangement: Horizontal
6. Face Arrangement: Perforated core.
7. Core Construction: Integral
8. Frame: 1 inch
9. Mounting: Countersunk screw

2.3. SOURCE QUALITY CONTROL

A. Verification of Performance: Rate registers and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1. EXAMINATION

A. Examine areas where registers and grilles are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

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

3.2. INSTALLATION

A. Install registers and grilles level and plumb.

B. Outlets and Inlets Locations: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install registers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3. ADJUSTING

A. After installation, adjust registers and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713.23

SECTION 23 81 26

SPLIT SYSTEM AIR CONDITIONERS

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2. SUMMARY

A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.3. ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

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

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

C. Samples for Initial Selection: For units with factory-applied color finishes.

1.4. INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Warranty: Sample of special warranty.

1.5. CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.6. MAINTENANCE MATERIAL SUBMITTALS

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

1. Filters: **One** set(s) for each air-handling unit.
2. Gaskets: **One** set(s) for each access door.

1.7. QUALITY CONTROL

A. Field Quality Control Services including Testing and Inspections are the responsibility of the contractor.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. ASHRAE Compliance:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - " Procedures," and Section 7 - "Construction and System Start-up."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.8. COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."

B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.9. WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

1. Warranty Period:
   a. For Compressor **Five** year(s) from date of Substantial Completion.
   b. For Parts: **Five** year(s) from date of Substantial Completion.
   c. For Labor: **Five**year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

2.2. INDOOR UNITS (5 TONS OR LESS)

A. Concealed Evaporator-Fan Components:

1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
2. Insulation: Faced, glass-fiber duct liner.
3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-

4. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
5. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
6. Fan Motors:
    a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
    b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
    c. Wiring Terminations: Connect motor to chassis wiring with plug connection.
7. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
8. Filters: Permanent, cleanable.
9. Condensate Drain Pans:
    a. Fabricated with [**one**] [**two**] percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
        (1) Length: Extend drain pan downstream from leaving face
        (2) Depth: A minimum of **2 inches** deep.
    b. Single-wall, **galvanized**-steel sheet.
    c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on **both ends** of pan.
        (1) Minimum Connection Size: **NPS 1**
    d. Pan-Top Surface Coating: Asphaltic waterproofing compound.
    e. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

B. Floor-Mounted, Evaporator-Fan Components:

1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect.
    a. Discharge Grille: Steel with surface-mounted frame
    b. Insulation: Faced, glass-fiber duct liner.
    c. Drain Pans: Galvanized steel, with connection for drain; insulated.
2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
3. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
4. Fan: Direct drive, centrifugal**,**
5. Fan Motors:

a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

b. Multitapped, multispeed with internal thermal protection and permanent lubrication.

6. Air Filtration Section:

a. General Requirements for Air Filtration Section:

(1) Comply with NFPA 90A.

(2) Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.

(3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.

b. Disposable Panel Filters:

(1) Factory-fabricated, viscous-coated, flat-panel type.

(2) Thickness: **2 inches**

(3) MERV according to ASHRAE 52.2: 13.

(4) Media: Interlaced glass fibers sprayed with nonflammable adhesive[

(5) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.

c. General Requirements for Air Filtration Section:

(1) Comply with NFPA 90A.

(2) Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.

(3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum

2.3. OUTDOOR UNITS 5 TONS OR LESS)

A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
   a. Compressor Type: Scroll.
   b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
   c. Refrigerant Charge: **R-410A**.
   d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.
3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.

4. Fan: Aluminum-propeller type, directly connected to motor.
5. Motor: Permanently lubricated, with integral thermal-overload protection.
6. Low Ambient Kit: Permits operation down to 45 deg F (7 deg C).
7. Mounting Base: Polyethylene.

B. Control equipment and sequence of operation are specified in Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC."

C. Thermostat: Low voltage with subbase to control compressor and evaporator fan.

D. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:

1. Compressor time delay.
2. 24-hour time control of system stop and start.
3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
4. Fan-speed selection including auto setting.

E. Automatic-reset timer to prevent rapid cycling of compressor.

F. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

G. Refrigerant Tubing Insulation: Provide ½" closed cell elastomeric insulation on Suction refrigerant line.

H. Drain Piping: For condensate: ¾" PVC

I. Additional Monitoring:

1. Monitor constant and variable motor loads.
2. Monitor variable-frequency-drive operation.
3. Monitor economizer cycle.
4. Monitor cooling load.
5. Monitor air distribution static pressure and ventilation air volumes.

2.4. CAPACITIES AND CHARACTERISTICS

A. Cooling Capacity:

1. Refer to Equipment Schedules.

B. Heating Capacity:

3. Refer to Equipment Schedules

C. Indoor Unit:

1. Fan Motor Electrical Characteristics:
   a. Volts: **230**
   b. Phase: **Single**
   c. Hertz: 60.

2. Airflow: 700 cfm

D. Outdoor Unit:

1. Type: Air cooled
2. Electrical Characteristics:
   a. Volts: 208/230
   b. Phase: Single
   c. Hertz: 60.
   d. Minimum Circuit Ampacity13.1
   e. Maximum Overcurrent Protection: 25
   f. Fan Motor Full-Load Amperes:
   g. Compressor Full-Load Amperes:
   h. Compressor Locked-Rotor Amperes

PART 3 - EXECUTION

3.1. INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Equipment Mounting:

1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete." Section 033053 "Miscellaneous Cast-in-Place Concrete."
2. Install ground-mounted, compressor-condenser components on polyethylene mounting base.
3. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
4. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

D. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2. CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

1. Water Coil Connections: Comply with requirements specified in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties." Connect hydronic piping to supply and return coil connections with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.

2. Remote, Water-Cooled Condenser Connections: Comply with requirements specified in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties." Connect hydronic piping to supply and return connections with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.

B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

C. Duct Connections: Duct installation requirements are specified in Section 233113 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply[**and return**] ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 233300 "Air Duct Accessories."

3.3. FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.4. STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup check according to manufacturer's written instructions.

3.5. DEMONSTRATION

A. DGS's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 238126

SECTION 26 05 11
COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Grout.
5. Common electrical installation requirements.
6. Electrical Testing

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For sleeve seals.

1.5 QUALITY CONTROL

A. Field Quality Control Services including Testing and Inspections are the responsibility of the contractor.

1.6 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.

3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

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.

D. Coordinate work with the Department hired Testing Agency to provide adequate time and access to the work for quality control testing.

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

A. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

B. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

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. Calpico, Inc.
c. Metraflex Co.
d. Or equal as approved by the professional.

2. Sealing Elements: EPDM 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. 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.

E. Right of Way: Give to piping systems installed at a required slope.

F. Provide Electrical Testing as indicated in the Contract Documents.

G. All equipment shall bear the UL (Underwriter's Laboratories, Inc) Label. Equipment shall be installed in accordance with the requirements of UL and the manufacturer.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. 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 above finished floor level.

G. Size pipe sleeves to provide 1/4-inch 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.

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.

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 cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

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.

END OF SECTION 26 05 11

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. This Section includes the following:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

B. Related Sections include the following:

1. Division 26 Section "Medium-Voltage Cables" for single-conductor, cable splices, and terminations for electrical distribution systems 15,000 V.

1.3 SUBMITTALS

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

B. Qualification Data: For testing agency.

C. Field quality-control test reports.

1.4 QUALITY CONTROL

A. Field Quality Control Services including Testing and Inspections are the responsibility of the contractor.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100.

C. Comply with NFPA 70.

1.5 COORDINATION

A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

B. Coordinate work with the Department hired Testing Agency to provide adequate time and access to the work for quality control testing.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Alcan Products Corporation; Alcan Cable Division.
2. American Insulated Wire Corp.; a Leviton Company.
3. Southwire Company.
4. Or equal as approved by the professional

B. Copper Conductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN/THWN-2.

2.2 CONNECTORS AND SPLICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
2. Hubbell Power Systems, Inc.
3. 3M; Electrical Products Division.
4. Or equal as approved by the professional.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.

B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

D. Exposed Branch Circuits, Including in Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.

F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

G. Class 1 Control Circuits: Type THHN/THWN-2, in raceway.

H. Class 2 Control Circuits: Type THHN/THWN-2, in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 FIELD QUALITY CONTROL

A. The Department will perform field quality control testing and inspection.

B. Coordinate work with Department hired Testing Agency to provide adequate time and access to the work for quality control testing.

END OF SECTION 26 05 19

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. This Section includes methods and materials for grounding systems and equipment.

1.3 SUBMITTALS

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

B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:

1. Ground rods.

C. Qualification Data: For testing agency and testing agency's field supervisor.

D. Field quality-control test reports.

1.4 QUALITY CONTROL

A. Field Quality Control Services including Testing and Inspections are the responsibility of the contractor.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100.

C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.

2.2 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by10 feet in diameter.

2.4 METHANOL FACILITY

A. All motors and electrical equipments shall be bonded with main electrical grounding system of the Denite building

B. Provide warning sign at location shown on the drawing. The warning sign shall maximum 24”X18” adequately supported as site condition may require. Mount sign on 1”x1” PVC coated channel as shown on drawing. Sign shall be built of heavy duty steel sheet. It shall be bonded along the edges of the plywood with 1”x4” wood strip fastened flat to the edge of the sign at the middle of the width of the strip.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger, unless otherwise indicated.

B. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors.
3. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

D. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using

one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

E. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

3.4 FIELD QUALITY CONTROL

A. Testing: The Department will perform field quality control inspection and testing. The maximum ground resistance shall not be more than 5 ohms.

B. Coordinate work with the Department hired testing Agency to provide adequate time and access to the work for quality control testing.

END OF SECTION 26 05 26

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.3 DEFINITIONS

A. RMC: Rigid metal conduit.

B. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.

1.6 QUALITY CONTROL

A. Field Quality Control Services including Testing and Inspections are the responsibility of the contractor.

B. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

C. Coordinate work with the Department hired testing Agency to provide adequate time and access to the work for quality control testing.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Allied Tube & Conduit.
b. Cooper B-Line, Inc.; a division of Cooper Industries.
c. ERICO International Corporation.
d. Or equal as approved by the professional.

2. Metallic Coatings: Hot-dip galvanized after fabrication in accordance with ASTM 123 and applied according to MFMA-4.
3. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel (hot-dip galvanized after fabrication in accordance with ASTM 123) hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars, hot-dip galvanized after fabrication in accordance with ASTM 123.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

G. Mechanical-Expansion Anchors: Insert-wedge-type, Stainless Steel Type 304, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

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. Cooper B-Line, Inc.; a division of Cooper Industries.
    b. Empire Tool and Manufacturing Co., Inc.
    c. Hilti Inc.
    d. Or equal as approved by the professional.

2. Concrete Inserts: Stainless Steel Type 304
3. Through Bolts: Stainless Steel Type 304, structural type, hex head, and high strength. Comply with ASTM A 325.
4. Toggle Bolts: Stainless Steel Type 304 springhead type.
5. Hanger Rods: Threaded Stainless Steel Type 304

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
6. To Light Steel: Sheet metal screws.
7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi, 28-day compressive-strength concrete, unless otherwise noted.

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.4 PAINTING

A. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 05 29

SECTION 26 05 33
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

B. Related Sections include the following:

1. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. LFMC: Liquid-tight flexible metal conduit.

C. NBR: Acrylonitrile-butadiene rubber.

D. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Structural members in the paths of conduit groups with common supports.
2. Process piping, HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.

1.5 QUALITY CONTROL

A. Field Quality Control Services including Testing and Inspections are the responsibility of the contractor.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100.

C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Allied Tube & Conduit; a Tyco International Ltd. Co.
4. Or equal as approved by the professional.

B. Rigid Aluminum Conduit: ANSI C80.5.

C. LFMC: Flexible steel conduit with PVC jacket.

D. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
2. Insulating Bushings: Plastic, 105 degree C minimum temperature rating
3. Insulated Grounding Bushings: Malleable Iron with plastic liner, 105 degree C minimum temperature rating

2.2 NONMETALLIC CONDUIT AND TUBING

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
2. Lamson & Sessions; Carlon Electrical Products.
3. Thomas & Betts Corporation.
4. Or equal as approved by the professional.

B. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.

C. Fittings for RNC: NEMA TC 3; match to conduit or tubing type and material.

2.3 METAL WIREWAYS

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. Cooper B-Line, Inc.
2. Hoffman.
3. Square D; Schneider Electric.
4. Or equal as approved by the professional.

B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Screw-cover type.

E. Finish: Manufacturer's standard enamel finish.

2.4 BOXES, ENCLOSURES, AND CABINETS

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. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
3. O-Z/Gedney; a unit of General Signal.
4. Or equal as approved by the professional.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, aluminum, Type FD, with gasketed cover.

D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

E. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

F. Custom made junction boxes shall be UL Listed, 14 gauge minimum sheet metal thickness, unless otherwise noted.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: Rigid Aluminum Conduit.
2. Concealed Conduit, Aboveground: Rigid Aluminum Conduit.
3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Comply with the following indoor applications, unless otherwise indicated:

1. Exposed Conduit: Rigid Aluminum Conduit.
2. Concealed Conduit: Rigid Aluminum Conduit.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
4. Boxes and Enclosures: NEMA 250, Type 3R.

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid Aluminum Conduit: Use threaded aluminum conduit fittings, unless otherwise indicated.

E. Do not install aluminum conduits in contact with concrete or earth.

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Raceway Terminations: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG. Provide insulated grounding bushings where required by NFPA 70 or the Contract Documents.

G. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.

H. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where otherwise required by NFPA 70.

I. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

3.3 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 05 33

SECTION 26 05 43

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. This Section includes the following:

1. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct banks, and in single duct runs.
2. Manholes.

1.3 DEFINITION

A. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Duct-bank materials, including separators and miscellaneous components.
2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
3. Accessories for manholes, handholes, and boxes.

B. Shop Drawings for Precast or Factory-Fabricated Underground Utility Structures: Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:

1. Duct entry provisions, including locations and duct sizes.
2. Reinforcement details.
3. Frame and cover design and manhole frame support rings.
4. Ladder details.
5. Grounding details.
6. Dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
7. Joint details.

C. Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.

1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.

D. Product Certificates: For concrete and steel used in precast concrete manholes and handholes, as required by ASTM C 858.

E. Source quality-control test reports.

F. Field quality-control test reports.

1.5 QUALITY CONTROL

A. Field Quality Control Services including Testing and Inspections are the responsibility of the contractor.

B. Comply with ANSI C2.

C. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

B. Store precast concrete underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

C. Lift and support precast concrete units only at designated lifting or supporting points.

1.7 COORDINATION

A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.

B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Engineer.

PART 2 - PRODUCTS

2.1 DUCTS

A. RNC: NEMA TC 2, Type EPC-40-PVC and Type EPC-80-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.2 NONMETALLIC DUCT ACCESSORIES

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. ARNCO Corp.
2. Lamson & Sessions; Carlon Electrical Products.
3. Spiraduct/AFC Cable Systems, Inc.
4. Or equal as approved by the professional.

B. Duct Accessories:

1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
2. Warning Tape: Underground-line warning tape specified in Division 26 Section "Identification for Electrical Systems."

2.3 MANHOLES

A. PRECAST MANHOLES

1. Precast Units: ASTM 478, with interlocking mating sections, complete with accessories, hardware, and features as indicated. Include concrete knockout panels for conduit entrance and sleeve for ground rod.
2. Design and fabricate structure according to ASTM C 858.
3. Design structure according to details on Drawings.
4. Structural Design Loading: ASTM C 857, Class A-16, as indicated for aircraft rated structures.
5. Joint Sealant: Continuous extrusion of asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground water level at grade.
6. Source quality Control: Inspect structures according to ASTM C 1037.

B. CAST-IN-PLACE MANHOLES

1. Loading: as indicated on drawing. Also see Structural and/or Civil drawings and specifications for manhole requirements.

2.4 UTILITY STRUCTURE ACCESSORIES

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. Bilco Company (The).
2. Campbell Foundry Company.
3. Carder Concrete Products.
4. Or equal as approved by the professional.

B. Manhole Frames, Covers, and Chimney Components: Comply with structural design loading specified for manhole.

1. Frame and Cover: Weatherproof, gray cast iron complying with ASTM A 48/A 48M, Class 30B, with milled cover-to-frame bearing surfaces; 36" diameter clear opening, heavy duty.

a. Cover Finish: Nonskid finish.
b. Frame and Cover shall be Neenah R-1743 or approved equal.

2. Cover Legend: Cast in. Selected to suit system.

a. Legend: As indicated on the drawings.

3. Manhole Chimney Components: Precast concrete rings with dimensions matched to those of roof opening.

a. Mortar for Chimney Ring and Frame and Cover Joints: Comply with ASTM C 270, Type M, except for quantities less than 2.0 cu. ft. where packaged mix complying with ASTM C 387, Type M, may be used.

C. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2-inch- diameter eye, and 1-by-4-inch bolt.

1. Working Load Embedded in 6-Inch, 4000-psi Concrete: 13,000-lbf minimum tension.

D. Pulling-In and Lifting Irons in Concrete Floors: 7/8-inch- diameter, hot-dip galvanized, bent steel rod; stress relieved after forming; and fastened to reinforcing rod. Exposed triangular opening.

1. Ultimate Yield Strength: 40,000-lbf shear and 60,000-lbf tension.

E. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch ID by 2-3/4 inches deep, flared to 1-1/4 inches minimum at base.

1. Tested Ultimate Pullout Strength: 12,000 lbf minimum.

F. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2-inch bolt, 5300-lbf rated pullout strength, and minimum 6800-lbf rated shear strength.

G. Cable Rack Assembly: Nonmetallic. Components fabricated from nonconductive, fiberglass-reinforced polymer.

1. Stanchions: Nominal 36 inches high by 4 inches wide, with minimum of 9 holes for arm attachment.
2. Arms: Arranged for secure, drop-in attachment in horizontal position at any location on cable stanchions, and capable of being locked in position. Arms shall be available in lengths ranging from 3 inches with 450-lb minimum capacity to 20 inches with 250-lb

minimum capacity. Top of arm shall be nominally 4 inches wide, and arm shall have slots along full length for cable ties.

3. A minimum of 2 stanchions shall be provided per manhole and handhole wall (8 total per manhole and handhole). Provide a minimum of 3 cable racks per stanchion. Each cable rack shall be 14" in length.

H. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, and not deterious to cable insulation. Capable of adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals. Sealing compound will not flow up to 250 degrees F. Sealing compound will not become brittle at minus 30 degrees F. Duct-Sealing compound shall be O-Z Gedney DUX 1 or DUX 5, or approved equal.

I. Fixed Manhole Ladders: Arranged for attachment to roof and floor of manhole. Ladder and mounting brackets and braces shall be fabricated from hot-dip galvanized steel.

J. Cover Hooks: Heavy duty, designed for lifts 60 lbf and greater. Two required.

2.5 SOURCE QUALITY CONTROL

A. Test and inspect precast concrete utility structures according to ASTM C 1037.

PART 3 - EXECUTION

3.1 UNDERGROUND ENCLOSURE APPLICATION

A. Manholes:

1. Provide ladder, cable racks, and manhole frame and cover inside manhole. Center ladder on manhole opening. Provide cable racks as required plus 100% spare on each manhole wall.

2. Provide ground rod outside manhole. Connect manhole ladder and manhole frame to the ground rod through a #4/0 bare copper wire.

3.2 EARTHWORK

A. Excavation and Backfill: Do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching.

D. Cut and patch existing pavement in the path of underground ducts and utility structures.

3.3 DUCT INSTALLATION

A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.

B. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.

C. Duct Entrances to Manholes and Concrete Handholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch ducts, and vary proportionately for other duct sizes.

1. Begin change from regular spacing to end-bell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line.
2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.
3. Grout end bells into structure walls from both sides to provide watertight entrances.

D. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.

E. Pulling Cord: Install 200-lbf- test nylon cord in ducts, including spares.

F. Concrete-Encased Ducts: Support ducts on duct separators.

1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.

    a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
    b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing rod dowels extending 18 inches into concrete on both sides of joint near corners of envelope.

3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.

4. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
5. Stub-Ups: Use manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Extend concrete encasement throughout the length of the elbow.
6. Warning Tape: Bury warning tape approximately 12 inches below grade, above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches of the centerline of duct bank.

G. Direct-Buried Duct Banks:

1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
2. Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches between tiers.
3. Excavate trench bottom to provide firm and uniform support for duct bank.
4. Install backfill.
5. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4 inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction.
6. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Concrete encase elbows for stub-up ducts throughout the length of the elbow.

3.4 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

A. Precast Concrete Handhole and Manhole Installation:

1. Comply with ASTM C 891, unless otherwise indicated.
2. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.

B. Manhole Access: Circular opening in manhole roof; sized to match cover size.
1. Install chimney, constructed of precast concrete collars and rings to support frame and cover and to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for cast-iron frame to chimney.

C. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and cable arms, as required for installation and support of cables and conductors and as indicated.

D. Warning Sign: Install "Confined Space Hazard" warning sign on the inside surface of each manhole cover.

3.5 GROUNDING

A. Ground underground ducts and utility structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.6 FIELD QUALITY CONTROL

A. Testing: The Department will perform field quality control inspection and testing.

B. Coordinate work with the Department hired testing Agency to provide adequate time and access to the work for quality control testing.

3.7 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION 26 05 43

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. This Section includes the following:

1. Identification for raceway.
2. Identification for conductors and communication and control cable.
3. Underground-line warning tape.
4. Warning labels and signs.
5. Instruction signs.
6. Equipment identification labels.
7. Miscellaneous identification products.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.4 QUALITY CONTROL

A. Field Quality Control Services including Testing and Inspections are the responsibility of the contractor.

B. Comply with ANSI A13.1 and ANSI C2.

C. Comply with NFPA 70.

D. Comply with 29 CFR 1910.145.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation

and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Color for Printed Legend:

1. Power Circuits: Black letters on an orange field.
2. Legend: Indicate system or service and voltage, if applicable.

C. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.

2.2 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.3 UNDERGROUND-LINE WARNING TAPE

A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.

1. Not less than 6 inches wide by 4 mils thick.
2. Compounded for permanent direct-burial service.
3. Embedded continuous metallic strip or core.
4. Printed legend shall indicate type of underground line.

2.4 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

C. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

2.5 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.6 EQUIPMENT IDENTIFICATION LABELS

A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.

1. Minimum Width: 3/16 inch.
2. Tensile Strength: 50 lb, minimum.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black, except where used for color-coding.

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 APPLICATION

A. Accessible Raceways, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A: Identify with orange self-adhesive vinyl label.

B. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, self-adhesive vinyl tape applied in bands:

1. Fire Alarm System: Red.
2. Control Wiring: Green and red.

C. Power-Circuit Conductor Identification: For primary and secondary conductors No. 1/0 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use marker tape. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.

D. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.

1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:

a. Power transfer switches.
b. Controls with external control power connections.

E. Manhole Warning Sign

1. Install "Confined Space Hazard" warning sign suspended from the manhole roof through plastic chain. Warning sign shall be non-metallic type.

Instruction Signs:

2. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
3. Emergency Operating Instructions: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for manual power transfer.

F. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power,

lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

    a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where 2 lines of text are required, use labels 2 inches high.
    b. Outdoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label.
    c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.

2. Equipment to Be Labeled:

    a. Panelboards, electrical cabinets, and enclosures.
    b. Access doors and panels for concealed electrical items.
    c. Electrical switchgear and switchboards.
    d. Transformers.
    e. Electrical substations.
    f. Motor-control centers.
    g. Disconnect switches.
    h. Enclosed circuit breakers.
    i. Motor starters.
    j. Push-button stations.
    k. Monitoring and control equipment.

3.2 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

F. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

G. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded feeder, and branch-circuit conductors.

1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.
2. Colors for 208/120-V Circuits:

    a. Phase A: Black.
    b. Phase B: Red.
    c. Phase C: Blue.
    d. Neutral: White
    e. Ground: Green

3. Colors for 480/277-V Circuits:

    a. Phase A: Brown.
    b. Phase B: Orange.
    c. Phase C: Yellow.
    d. Neutral: White
    e. Ground: Green

4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

H. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 12 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench.

I. Testing: The Department will perform field quality control inspection and testing

END OF SECTION 26 05 53

SECTION 26 09 23

LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions to the Construction Contract”, “Special Conditions”, and “Division 01 – General Requirements” form a part of this Section by the reference thereto and shall have the same force and effects as if printed herewith in full.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

A. Section Includes:

1. Time switches.
2. Exterior photoelectric sensors.
3. Indoor occupancy sensors.
4. Outdoor motion sensors.
5. Lighting contactors.

B. Related Sections:

1. Section 260519 “Low Voltage Electrical Power Conductors and Cables” for wire and cabling.

1.4 DEFINITIONS

A. LED: Light-emitting diode.

B. PIR: Passive infrared.

1.5 SUBMITTALS

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

B. Shop Drawings: Show installation details for occupancy, photoelectric sensors and emergency relay control devices.

1. Interconnection diagrams showing field-installed wiring.
2. Submit typical wiring diagrams for all components including, but not limited to, photosensors, time switches, emergency relay control devices and occupancy sensors.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.6 WARRANTIES

A. Indoor occupancy sensors, photosensors, time switches and emergency relay control devices shall have a standard five (5) year warranty.

1.7 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including luminaires, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

1.8 QUALITY CONTROL

A. Field Quality Control Services including Testing and Inspections are the responsibility of the contractor.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to Authorities Having Jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 TIME SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Intermatic, Inc.
2. Cooper Industries, Inc.
3. TORK.
4. Or equal as approved by the professional.

B. Electromechanical-Dial Time Switches: Comply with UL 917.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Contact Rating: 20-A ballast load, 120-/240-V ac.
3. Circuitry: Allows connection of a photoelectric relay as a substitute for the on-off function of a program.

4. Astronomic time dial.
5. Provide timer 0-60 minutes

2.2 EXTERIOR PHOTOELECTRIC SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Lutron.
   2. Leviton.
   3. Hubbell Building Automation.
   4. Or equal as approved by the professional.

B. Description: Solid state, with SPST dry contacts rated for 1800-VA to operate connected load, or contactor coils, complying with UL 773A.

   1. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range.
   2. Time Delay: 30-second minimum, to prevent false operation.
   3. Lightning Arrestor: Air gap type.
   4. Mounting: Twist lock complying with IEEE C136.10, with base.

2.3 INDOOR OCCUPANCY SENSORS

A. Manufacturers: Basis-of-Design Product: Subject to compliance with requirements, provide products by Lutron Electronics or comparable product approved by Cleveland Clinic.

B. General Description: Ceiling or wall mounting, solid-state type with a separate relay unit and isolated output.

   1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable in ten (10) minute increments to a maximum setting of sixty (60) minutes.
   2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
   3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
   4. Mounting:

      a. Sensor: Suitable for mounting in any position on a standard outlet box.
      b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
      c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

   5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
   6. Bypass Switch: Override the ‘on’ function in case of sensor failure.
   7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keep lighting off when selected lighting level is present.
   8. Sensors shall be UL listed.
   9. Communications capability with daylighting function.
   10. Five year warranty.
   11. Fully compatible with lighting control system/dimming system and shall communicate

with said system.

12. Color to be white, ivory or grey. Custom colors to be coordinated with the Architect.

C. Dual-Technology Low Voltage Type with Power Pack: Ceiling or wall mounting; detect occupancy/vacancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
3. Detection Coverage (Standard Room): 360º coverage, detect occupancy anywhere in the following areas when mounted on a 96-inch high ceiling.
   a. Up to 1000 sq. ft. for normal range.
   b. Up to 2000 sq. ft. for extended range.
4. Operating Environment: Operating temperature 32º-104ºF with a relative humidity (non-condensing) of 0% to 95%.
5. Color to be white, ivory or grey. Custom colors to be coordinated with the Architect.

D. Dual-Technology Line Voltage Dual Relay Type: Wall mounted for dual level control; detect occupancy/vacancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
3. Detection Coverage (Standard Room): 180º coverage, detect occupancy anywhere in the following areas when mounted on wall.
   a. Up to 225 sq. ft. for utilizing dual technology.
4. Operating Environment: Operating temperature 32º-104ºF with a relative humidity (non-condensing) of 0% to 95%.
5. Dual Relay.
6. Dual button.

2.4 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multi-conductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multi-conductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power

Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including luminaires, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions. Allow six (6) feet of cable slack for sensor location adjustment.

3.2 WIRING INSTALLATION

A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 3/4 inch.

B. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

C. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.3 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."
   1. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches with a unique designation.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: **Engage** a qualified testing agency to evaluate lighting control devices and perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following field tests and inspections:

   1. Operational Test: After installing time switches, sensors, and other lighting controls, and after electrical circuitry has been energized, start units to confirm proper unit operation. Verify operation of each lighting control device and adjust time delays.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and

equipment.

D. Lighting control devices will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

END OF SECTION 260923

SECTION 26 24 16
PANELBOARDS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

1.3 SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
6. Include wiring diagrams for power, signal, and control wiring.
7. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

C. Qualification Data: For qualified testing agency.

D. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

E. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

F. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. Include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.4 QUALITY CONTROL

A. Field Quality Control Services including Testing and Inspections are the responsibility of the contractor.

B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70.

D. Comply with NEMA PB 1.

E. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.6 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

1.7 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Enclosures: Flush- or surface-mounted cabinets, as indicated on the drawings.

1. Rated for environmental conditions at installed location. See drawings for NEMA 250 enclosure type.
2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
3. Finishes:

a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
b. Back Boxes: Galvanized steel.

4. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.

B. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

C. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Main and Neutral Lugs: Mechanical type.
3. Ground Lugs and Bus-Configured Terminators: Mechanical type.

D. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

E. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

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. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Square D; a brand of Schneider Electric.
4. Or equal as approved by the professional.

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches high, provide two latches, keyed alike.

D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

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. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Square D; a brand of Schneider Electric.
4. Or equal as approved by the professional.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

D. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

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. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Square D; a brand of Schneider Electric.
4. Or equal as approved by the professional.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
4. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
5. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.
    b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
    c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
    d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    e. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
    f. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
    g. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in off position for circuit breakers sizes 250A and larger
    h. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.

PART 3 - EXECUTION

3.1 APPLICATION

A. Provide “Distribution Panelboards” for panelboards that meet any of the following criteria:
1. There is any branch circuit breaker that exceeds 100A.
2. The rating of the main lugs or main circuit breaker exceeds 225A.

B. Any panelboards that are not “Distribution Panelboards” shall be “Lighting and Appliance Branch-Circuit Panelboards”, unless otherwise noted on the drawings.

3.2 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

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

3.3 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Install all panelboards except located in electrical room inside the fiber glass enclosure. Enclosure shall be lockable type and watertight. Mount enclosure on engineered ¼" thick plywood.

C. Mount panelboard at one of the following mounting heights, whichever is lower, unless otherwise indicated on the drawings:
   1. Mount top of trim of the panelboard at 90 inches above finished floor or grade.
   2. Mount panelboard such that the top-most breaker is not higher than 79 inches above finished floor or grade.

D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

E. Install overcurrent protective devices and controllers not already factory installed.

   1. Set field-adjustable, circuit-breaker trip ranges.

F. Install filler plates in unused spaces.

G. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

H. Comply with NECA 1.

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Electrical Identification."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Department's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical System."

3.5 FIELD QUALITY CONTROL

A. Testing Agency: The Department will perform field quality control testing and inspection.

B. Coordinate work with the Department hired testing Agency to provide adequate time and access to the work for quality control testing

3.6 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination."

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.7 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 26 24 16

SECTION 26 26 53
ELECTRIC VEHICLE CHARGING EQUIPMENT - LEVEL 2

PART 1 - GENERAL

1.1. STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.1 SUMMARY

A. Section includes EV charging equipment that provides Level 2 EV charging.

1.2 DEFINITIONS

A. EV: Electric vehicle.

B. EV Cable: The off-board cable containing the conductor(s) to connect the EV power controller to the EV that provides both power and communications during energy transfer.

C. EV Capable: Parking spaces that include nearby termination of raceway (conduit) to a power source with sufficient electrical panel capacity designed for simultaneous charging of electric vehicles in all planned EV parking spaces. Electrical wiring need not be pulled through raceway (conduit) until charging station is installed.

D. EV Charger or EV Charging Equipment: See "EVSE".

E. EV Connector: A conductive device that, when electrically coupled to an EV inlet, establishes an electrical connection to the EV for the purpose of power transfer and information exchange. This device is part of the EV coupler.

F. EV Coupler: A mating EV inlet and connector set.

G. EV Inlet: The device in the vehicle into which the EV connector is inserted, and a conductive connection is made for the transfer of power and communication. This device is part of the EV coupler.

H. EV Make Ready: Parking spaces that include nearby termination of raceway (conduit) and electrical wiring pulled to a power source with sufficient electrical panel capacity for simultaneous charging of electric vehicles in all EV parking spaces.

I. EVSE: Electric Vehicle Supply Equipment. It includes the EV charging equipment and conductors, including the ungrounded, grounded, and equipment grounding conductors and EV cables, attachment plugs, and all other fittings, devices, power outlets, or apparatus installed specifically for transferring energy between the premise wiring and the EV.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for EV charging equipment.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Sustainable Design Submittals:

1. Plan showing location and number of EV charging units, and distance from building.
2. Plan showing "reasonable accessibility" to EV charging units.
3. Plan showing location and number of EV charging units, charging levels and connectors, and ability of EV charging units to participate in a demand-response or time-of-use pricing program, as well as a power load management system that allows for an increased number of charging stations than would otherwise be feasible without power load management.

C. Shop Drawings: For EV charging equipment.

1. Include plans, elevations, sections, and **mounting** details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of mounting assemblies for EV charging equipment.
4. Include diagrams for power, signal, and control wiring.
5. Include verification of wireless communications service at each location of EV charging equipment.

D. Product Schedule: For EV charging equipment. **Use same designations indicated on Drawings.**

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Area plans and details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Structural members to which equipment will be attached.
2. Electrical service.
3. Communications service**, including wireless communications equipment**.
4. Items penetrating finished **floor**.

B. Qualification Data: For **Installer**.

C. Field quality-control reports.

D. Sample Warranty: For manufacturer's warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For EV charging equipment to be included in operation and maintenance manuals.

B. Software and Firmware Operational Documentation:

1. Online training and help documentation.
2. Station activation sticker.

1.7 QUALITY CONTROL

A. Field Quality Control Services including Testing and Inspections are the responsibility of the contractor.

B. Field Quality Control Services including Testing and Inspections are the responsibility of the contractor.

C. Installer Qualifications: An authorized representative who is trained and approved by the manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

E. Comply with UL 2231-1. UL 2231-2, UL 2594, and NEC Article 625.

F. Comply with SAE J1772.

G. Comply with FCC Part 15 Class A.

1.8 FIELD CONDITIONS

A. Wireless Survey: Complete wireless survey to determine if wireless provider signals meet or exceed manufacturer's recommended minimum values.

B. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not exceeding minus 22 to plus 122 deg F (minus 30 to plus 50 deg C).
2. Altitude: Not exceeding 6600 feet (2000 m).

C. Rate Equipment for non-operation under the following conditions:

1. Ambient Temperature: Not exceeding minus 40 to plus 140 deg F (minus 40 to plus 60 deg C).
2. Altitude: Not exceeding 6600 feet (2000 m).

D. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by the Department or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify **Construction Manager** no fewer than **two** days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without **Construction Manager's** written permission.

1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components of EV charging units that fail(s) in materials or workmanship within specified warranty period.

1. Standard Warranty Period: One year from date of Substantial Completion.
2. Extended Warranty Period: **Three** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Provide ChargePoint CT4000 family of electric vehicle charging stations for commercial applications; and ChargePoint CPF25 family of electric vehicle charging stations for dedicated Fleet charging and multifamily resident personal charging applications.

B. Source Limitations: Obtain EV charging equipment from single manufacturer.

2.2 EV CHARGING EQUIPMENT DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Comply with NFPA 70.

C. ADA compliant.

D. Metering: +/- 2 percent from 2 percent to full scale of output (30 A).

E. EV Charging Equipment Mounting: **Bollard mount**.

F. Enclosures:

1. Rated for environmental conditions at installed location.

a) Indoor Locations: NEMA 250, Type 3R.
b) Outdoor Locations: NEMA 250, Type 3R.
c) Aluminum and UV-resistant plastic.
d) Paint and Anodized.
e) Charging components protected by security screws.
f) Charging connectors in locking holsters.
g) Meter, modem, and CPU, tamper resistant.

G. EV Cable and Connectors:

1. SAE J1772 connector.
2. **Two** connectors with locking holster.
3. **18-foot (5.5 m)**] [**23-foot (7.5-m)**] cable with cable management system.

H. Status Indicators:

1. LEDs to indicate power, vehicle charging, charging complete, system status, faults, and service, as well as authorization.

I. Display Screen:

1. VGA-resolution, daylight-viewable LCD screen with UV protection. Daylight readable and fingerprint resistant.
2. Displays power, charging, charging complete, remote control, system status, faults, payment and pricing details, and service.

J. Networking:

1. WAN Communications: Cellular GSM/GPRS and CDMA.
2. LAN Communications: 2.4 GHz Wi-Fi 802.11b/g/n.
3. Capable of remote configuration, diagnostics and reporting.
4. Capable of remote software updates (future proof).

K. Payment System:

1. RFID (ISO 15693, ISO 14443), NFC, Contactless credit card reader.
2. PCI (Payment Card Industry) compliant.
3. Capable of remote control and authorization including mobile phone application or toll-free phone number.

L. Charging Network: Compatible with the **ChargePoint** EV charging network or equal as approved by the professional.

1. Multiple units shall independently connect to charging network.
2. Multiple units shall have one unit designated as a master unit that is configured as a gateway unit between the EV charging equipment and the charging network.
3. Individual units shall be capable of indicating station status and availability providing or connecting user to customer support and remote control.

2.3 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

B. Surge Withstand: 6 kV at 3000 A.

C. Integral GFCI.

D. Auto-GFCI fault retry.

E. Input Power:

1. **40 A**, 208/240-V ac, 60 Hz, single phase per charger.
2. Dual circuits do not need to be interlocked.

F. EV Charging Levels:
1. Dual vehicles, AC Level 2 at up to 7.2 kW (CT4000 Charge Point) or up to 7.7 kW (CPF25) per vehicle.
2. Multiple vehicles simultaneously charging at a site using Automatic Power Load Management may be charged up to 7.2 kW (CT4000 Charge Point) or up to 7.7 kw (CPF25) per vehicle.
3. Or equal as approved by the professional.

2.4 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for EV charging equipment electrical conduit to verify actual locations of conduit connections before equipment installation.

C. Examine walls, floors, and pavement for suitable conditions where EV charging equipment will be installed.

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

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 413.

B. Concrete Base Mounting:

1. Install EV charging equipment on 6-inch (150-mm) nominal-thickness concrete base. Base should be 24-inch (600 mm) diameter or square (minimum 12-inch (300 mm) from the center located conduit stub-up). Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete".

    a) Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
    b) For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
    c) Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
    d) Install anchor bolts to elevations required for proper attachment to supported equipment.
    e) Secure EV charging equipment to concrete base according to manufacturer's written instructions.

2. Install EV charging equipment on 24-inch (600-mm) nominal-diameter and 24-inch (600-mm) concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete.

    a) Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
    b) Install anchor bolts to elevations required for proper attachment to supported equipment.
    c) Secure EV charging equipment to concrete base according to manufacturer's written instructions.

C. Bollard Mounting:

1. Allow a minimum of 24 inches (600 mm) of clearance around EV charging equipment.
2. EV charging equipment receptacles or holders shall be not less than 24 inches (600 mm) and not more than 4 feet (1.2 m) above finished grade.
3. Mount EV charging equipment plumb and rigid without distortion of enclosure.
4. Secure EV charging equipment according to manufacturer's written instructions.

D. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

E. Wiring Method: Install cables in raceways and cable trays. Conceal raceway and cables except in unfinished spaces.

1. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
2. Comply with requirements for underground raceways and enclosures specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems."

F. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

G. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

H. Circuit Breakers: Comply with Section 262816 "Enclosed Switches and Circuit Breakers."

I. Secure covers to enclosure.

3.3 CONNECTIONS

A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Comply with grounding requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

C. Comply with requirements for installation of conduit in Section 260533 "Raceways and Boxes for Electrical Systems." Drawings indicate general arrangement of conduit, fittings, and specialties.

D. 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-486B.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections **with the assistance of a factory-authorized service representative**.

C. Tests and Inspections:

1. For each unit of EV charging equipment, perform the following tests and inspections:

a) Unit self-test.

b) Operation test with load bank.
c) Operation test with EV.
d) Network communications test.

D. EV charging equipment will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. **Engage a factory-authorized service representative to perform** startup service.

1. Complete installation and startup check according to manufacturer's written instructions.

3.7 ONGOING MANAGEMENT SERVICES

A. Engage a station manufacturer that offers a service to manage the administration and policies of the electric vehicle charging stations on an ongoing basis.

3.8 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for the duration of an active ChargePoint Network Service Plan.

B. Upgrade Service: At Substantial Completion, remotely update software to latest version. Install and program software upgrades that become available while an active ChargePoint Network Service Plan is maintained. Upgrading software shall include operating system and new or revised licenses for using software.

3.9 DEMONSTRATION

A. Utilize ChargePoint Station Management Services and ChargePoint Assure Services, or the Department's maintenance personnel to adjust, operate, and maintain EV charging equipment.

END OF SECTION 26 26 53

SECTION 26 27 26
WIRING DEVICES

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. This Section includes the following:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Snap 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.

1.4 SUBMITTALS

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

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY CONTROL

A. Field Quality Control Services including Testing and Inspections are the responsibility of the contractor.

B. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100.

D. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
2. Leviton Mfg. Company Inc. (Leviton).
3. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).
4. Or equal as approved by the professional.

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Hubbell; HBL5351 (single), CR5352 (duplex).
b. Leviton; 5891 (single), 5352 (duplex).
c. Pass & Seymour; 5381 (single), 5352 (duplex).
d. Or equal as approved by the professional.

2.3 GFCI RECEPTACLES

A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Cooper; GF20.
b. Pass & Seymour; 2084.
c. Hubbell
d. Or equal as approved by the professional.

2.4 SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
b. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
c. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).
d. Or equal as approved by the professional.

2.5 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: 0.035-inch- (1-mm-) thick, satin-finished stainless steel
3. Material for Unfinished Spaces: 0.035-inch- (1-mm-) thick, satin-finished stainless steel
4. Material for Receptacles with self-closing lid: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover. Weatherproof while plug is inserted and cover is closed.

2.6 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.

1. Wiring Devices Connected to Normal Power System: White, unless otherwise indicated or required by NFPA 70 or device listing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the left.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

A. Testing: The Department will perform field quality control inspection and testing.

B. Coordinate work with the Department hired testing Agency to provide adequate time and access to the work for quality control testing.

END OF SECTION 26 27 26

SECTION 26 28 16
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. This Section includes the following individually mounted, enclosed switches and circuit breakers:

1. Fusible switches.
2. Nonfusible switches.
3. Molded-case circuit breakers.
4. Enclosures.

1.3 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

B. HD: Heavy duty.

C. RMS: Root mean square.

D. SPDT: Single pole, double throw.

1.4 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current rating.
4. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Qualification Data: For testing agency.

D. Field quality-control test reports including the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

E. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition, include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
2. Time-current curves, including selectable ranges for each type of circuit breaker.

1.5 QUALITY CONTROL

A. Field Quality Control Services including Testing and Inspections are the responsibility of the contractor.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100.

C. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
2. Altitude: Not exceeding 6600 feet (2010 m).

1.7 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

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. Spares: For the following:
   a. Fuses for Fusible Switches: Provide 3 spare fuses per switch

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 FUSIBLE AND NONFUSIBLE SWITCHES

A. Available Manufacturers:

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
3. Square D/Group Schneider.
4. Or equal as approved by the professional.

B. Fusible Switch, 1200 A and Smaller: NEMA KS 1, Type HD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Nonfusible Switch, 1200 A and Smaller: NEMA KS 1, Type HD, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

D. Provisions for padlocks: Fusible and non-fusible switches shall include provisions for being padlocked in the open and closed position.

E. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.
3. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.

2.3 MOLDED-CASE CIRCUIT BREAKERS AND SWITCHES

A. Available Manufacturers:

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
3. Square D/Group Schneider.
4. Or equal as approved by the professional.

B. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

C. Provisions for padlocks: Molded-Case Circuit-Breakers shall include provisions for being padlocked in the open and closed position.

D. Molded-Case Circuit-Breaker Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical style suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
4. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
5. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
6. Auxiliary Switch: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

2.4 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location. See drawings for NEMA 250 enclosure type.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.

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

3.2 INSTALLATION

A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.

B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Electrical Identification."

B. Enclosure Nameplates: Label each enclosure as specified in Division 26 Section "Electrical Identification."

3.4 FIELD QUALITY CONTROL

A. Testing: The Department will perform field quality control inspection and testing.

B. Coordinate work with the Department hired testing Agency to provide adequate time and access to the work for quality control testing

3.5 ADJUSTING

A. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination."

3.6 CLEANING

A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.

B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION 26 28 16

SECTION 26 51 00
INTERIOR LIGHTING

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. This Section includes the following:

1. Interior lighting fixtures, lamps, and ballasts.
2. Emergency lighting units.
3. Exit signs.

1.3 DEFINITIONS

A. BF: Ballast factor.

B. CRI: Color-rendering index.

C. CU: Coefficient of utilization.

D. HID: High-intensity discharge.

E. LER: Luminaire efficacy rating.

F. Luminaire: Complete lighting fixture, including ballast housing if provided.

G. RCR: Room cavity ratio.

1.4 SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.
2. Emergency lighting units including battery and charger.
3. Ballast.
4. Energy-efficiency data.
5. Life, output, and energy-efficiency data for lamps.

B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.

1. Wiring Diagrams: Power and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

1.5 QUALITY CONTROL

A. Field Quality Control Services including Testing and Inspections are the responsibility of the contractor.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100.

C. Comply with NFPA 70.

D. FMG Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.

1.6 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 INTERIOR LUMINAIRES

A. Product Description: Complete interior luminaire assemblies, with features, options, and accessories as scheduled.

2.2 LED LIGHTING FIXTURES AND COMPONENTS

A. Product Testing: Comply with U.L. 1598 and 8750. Test according to IES LM-79 and LM-80.

B. Drivers: Operation to be at standard rated voltage of driver, and not “over-driven.”.

2.3 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Incandescent Fixtures: Comply with UL 1598.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

F. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.
4. Laminated Silver Metallized Film: 90 percent.

G. Plastic Diffusers, Covers, and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

    a. Lens Thickness: At least 0.125 inch minimum unless different thickness is indicated.
    b. UV stabilized.

2. Glass: Annealed crystal glass, unless otherwise indicated.

2.4 EXIT SIGNS

A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:
1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.
2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.

    a. Battery: Sealed, maintenance-free, nickel-cadmium type, unless otherwise noted on the drawings
    b. Charger: Fully automatic, solid-state type with sealed transfer relay.
    c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored,

relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.

e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

2.5 EMERGENCY LIGHTING UNITS

A. Description: Self-contained units complying with UL 924.

1. Battery: Sealed, maintenance-free, lead-acid type.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

2.6 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.

E. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

F. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

B. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings: Support fixture directly from building structure.

1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches from lighting fixture corners.
2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
4. Install at least four independent support wires from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3. Wires shall be arranged to support the fixture directly from the building structure.

C. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

D. Air-Handling Lighting Fixtures: Install with dampers closed and ready for adjustment.

E. Adjust aimable lighting fixtures to provide required light intensities.

F. Connect wiring according to Division 26 Section "Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

C. Testing: The Department will perform field quality control inspection and testing.

D. Coordinate work with the Department hired testing Agency to provide adequate time and access to the work for quality control testing.

END OF SECTION 26 51 00

SECTION 26 56 19
EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Exterior luminaires with lamps and drivers.
2. Luminaire supports.
3. Luminaire-mounted photoelectric relays.

B. Coordination Requirements:

1. Coordinate the installation of all light fixtures with the work of other trades. This includes but is not limited to placement of fixtures in conjunction with civil work such as sidewalks, roadways, parking lots, landscaping and building exteriors.
2. Coordinate the installation of all light fixtures with mounting surfaces fixtures will be mounted within, onto, or through. Coordinate placement of fixture supports, anchors, and mounts in conjunction with ceiling and wall system supports, anchors and mounts. Light fixture trims shall be coordinated with ceiling and wall surfaces.
3. Coordinate the installation of all light fixtures with required external surge protection devices. See Part 2 for more on surge protection requirements.

1.3 SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, and finishes.

1. Submit manufacturer's product datasheet on each and every lighting fixture.
2. Furnish shop drawing portfolios (collated & bound sets) containing the following information:

a. Name of manufacturer, make and model of each fixture in the project.
b. Product listing information (UL, ETL, DLC, Dark Sky, etc.…)
c. Descriptive cut sheets Indicate fixture catalog number selections, highlight or make obvious which part numbers are used to build the complete fixture catalog number.
d. Complete photometric information and coefficient of utilization tables.
e. Fixture voltage, match to project specifics.
f. Wiring diagrams for power, control, and signal wiring.
g. Photoelectric relays and how they interconnect into the system schematically.
h. The number, type and wattage of the fixture lamps. Include lamp rated life, color temperature, color rending index (CRI), initial & mean lumen output.

i. The wattage and illumination information for LED fixtures. Include rated life, color temperature, CRI, initial & mean lumen output of LED fixtures.
j. Lens information including type, pattern, thickness, material type, special features.
k. Fixture options, mounting details and ceiling compatibility information.
l. Construction of fixture housing and door, door type, access hole information.
m. Fixture ballast and driver manufacturer and type information.
n. Means of attaching luminaries to supports and indication that the attachment is suitable for components involved.

3. All lighting fixtures required to be used on this project shall be submitted in one single submittal so that all fixtures can be reviewed at one time. Those fixtures not receiving a shop drawing action of "Reviewed" or "Reviewed and Noted" on the first submittal shall be resubmitted for review. A light fixture receiving a shop drawing action of "Resubmit" or "Rejected" after the third review for any reason, shall be furnished as originally specified.

4. The portfolios shall be made from standard manufacturer's specification sheets. Each fixture shall be identified by the letter or number indicated on the fixture schedule or project plan sheets as applicable. The combining of more than one fixture type of fixture on a single sheet shall not be acceptable.

B. Shop Drawings for nonstandard or custom lighting fixtures: Show details indicating dimensions, weights, methods of field assembly, components, features, and accessories. Product Certificates: For each type of ballast and driver, dimmer-controlled fixtures, provided by manufacturer.

C. Product Schedule: For all luminaires and lamps, using the same designations as on the Project Drawings.

D. Qualification Data: For testing laboratory providing photometric data for luminaires.

E. Product Certificates: For each luminaire type and for each photoelectric relay type.

F. Product Test Reports: For each luminaire, for tests performed by a qualified testing agency. Provide all applicable source quality-control reports.

G. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

H. Provide all applicable field quality-control reports.

I. Project Record Documents: Record actual connections and locations of luminaires and any associated remote mounted components. Provide this information along with project ‘as-builts’ per the contract documents plans and specifications.

J. Warranty: Provide a copy of the sample warranty prior to commencement of work. Include a copy of the final approved warranty in the project close out documentation.

1.4 QUALITY CONTROL

A. Field Quality Control Services including Testing and Inspections are the responsibility of the contractor.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with IEEE C2, "National Electrical Safety Code."

D. Comply with NFPA 70.

E. Manufacturers: Firms regularly engaged in the manufacturer of interior and exterior light fixtures of types and ratings required, whose products have been in satisfactory use in similar service for not less than three (3) years.

F. Installer: Qualified with at least three (3) years of successful installation experience on projects with interior and exterior lighting fixture work similar to that required for this project.

G. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

H. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products and complying with applicable IES testing standards.

I. Provide luminaires from a single manufacturer for each luminaire type.

J. Mockups: As required on a project-by-project basis (typically not required) for exterior luminaires, complete with power and control connections.

1. Obtain Architect's approval of luminaires in mockups before starting installations.
2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed work.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 REFERENCES

A. NEC Compliance: Comply with the NEC (NFPA 70) as applicable to the installation and construction of lighting fixtures.

B. NEMA Compliance: Comply with applicable requirements of NEMA Standard Pub. Nos. LE-1 and LE-2 pertaining to lighting equipment.

C. ANSI/UL Compliance: Comply with ANSI/UL Standards pertaining to interior and exterior lighting fixtures for hazardous locations. ANSI C82.11 - American National Standard for Lamp Ballasts - High Frequency Fluorescent Lamp Ballasts - Supplements.

D. IEEE C62.41.2 - Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits.

E. IESNA LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products; Illuminating Engineering Society.

F. IESNA LM-80 - Approved Method: Measuring Lumen Maintenance of LED Light Sources.

G. NECA 1 - Good Workmanship in Electrical Construction, latest edition.

H. NECA/IESNA 501 – Standard for Installing Exterior Lighting Systems, latest edition.

I. Underwriter's Laboratories (UL) Listings. Provide fixtures that have been UL Listed and labeled to any or all of the following standards as applicable to the project:

1. UL 844 - Luminaires for Use in Hazardous (Classified) Locations.
2. UL 924 - Emergency Lighting and Power Equipment.
3. UL 1598 - Luminaires.
4. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products.

1.6 DELIVERY, STORAGE AND PROTECTION

A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 501 (exterior lighting), NECA/IESNA 502 (industrial lighting), and all manufacturer's written instructions.

B. Keep fixtures in original product packaging until ready for installation. Do not leave unpackaged fixtures unattended or where they are subject to dirt, debris, or damage.

C. All fixtures shall be kept warm, dry, safe and secure. Adhere to manufacturer storage requirements.

D. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.7 EXTRA MATERIALS

A. At substantial completion of the project, furnish the following extra materials that match specified and installed products to the Department for future use after completion of project warranty periods. Extra materials shall be delivered and stored at a location or locations directed by the Department. Products shall be packaged with protective covering for storage and shall be suitably labeled by product type.

1. Provide ten extra lamps for every 100 lamps (of each rating and type) installed on the project. Provide a minimum of at least one extra lamp for each lamp type and rating used.
2. Provide one extra lens or louver for every 100 units (of each type) installed on the project. Provide a minimum of at least one extra lens and one extra louver for each type used.
3. Provide one extra driver for every 100 units (of each type) installed on the project. Provide a minimum of at least one extra driver for each type used.
4. Provide one extra set (complete set) of fuses for every 100 units (of each type) installed on the project. Provide a minimum of at least one set of fuses for each type used.

5. Provide one extra photoelectric relay for every 100 units (of each type) installed on the project. Provide a minimum of at least one extra photoelectric relay for each type used.

1.8 WARRANTY

A. Provide a five (5) year manufacturer warranty for all exterior fixtures, LED drivers, and LED light boards (light engines) from date of substantial completion of the project. This warranty to cover all product defects, performance criteria, and parts.

B. Manufacturer and installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures, including luminaire support components.
   b. Faulty operation of luminaires and accessories.
   c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

1.9 FIELD CONDITIONS

A. Mark locations of exterior luminaires for approval by Engineer and BCPS Project Manager prior to the start of luminaire installation.

PART 2 - PRODUCTS

2.1 FIXTURES, GENERAL

A. All fixtures shall be UL or other qualified third party listed for the environment where they will be installed including: damp, wet, extreme temperature, or hazardous locations.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.

D. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

1. LER Tests Incandescent Fixtures: Where LER is specified, test according to NEMA LE 5A.

E. Lateral Light Distribution Patterns: Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

F. Metal Parts: Free of burrs and sharp corners and edges.

G. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.

H. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

I. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

J. Exposed Hardware Material: Stainless steel.

K. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

L. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

M. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

N. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

O. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

P. Variations in Luminaire Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.

Q. Diffusers and Globes:

1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

R. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp and ballast characteristics:
   d. "USES ONLY" and include specific lamp type.
   e. Lamp diameter, shape, size, wattage and coating.
   f. CCT and CRI for all luminaires.

S. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant to withstand common vibrations encountered at installation site.

2.2 MANUFACTURERS

A. Manufacturers: As noted on the drawings by notes and/or by the light fixture schedule dictated by this Section. Provide equal as approved by the Professional,

2.3 LUMINAIRE SUPPORT COMPONENTS

A. Comply with general requirements found in the UNL Design Guidelines. Comply with all manufacturers written instructions for the physical characteristics and installation procedures.

2.4 LED LIGHTING FIXTURES

A. Complete LED lighting fixtures for general illumination shall have been tested by IES LM-79and LM-80 requirements.

B. LED light fixtures shall be fabricated, assembled, and manufactured as a complete fixture unit, including housing, mounting hardware, driver, light boards (light engines), and lens.

C. LED lighting fixtures shall allow for separate replacement of the light boards and driver. In other words, 'throw away' fixtures with non-replaceable components are not permitted.

D. LED lighting fixtures shall be capable of continuous dimming as a standard offering. Dimming range to be from 100% to at least 20% of rated lumen output. Dimming control shall be 0-10VDC.

E. All LED fixture control devices shall be compatible with the type of drivers and dimming requirements of the particular project and coordinated with the lighting fixture submittals prior to ordering.

F. Universal input voltage (120-277 VAC) drivers shall be provided for all LED applications.

G. In-line fusing: On the primary for each luminaire.

2.5 LED DRIVERS

A. Drivers shall operate from a 60Hz input AC voltage from 120V-277V. Unit shall have an input voltage tolerance range of at least +/- 10%.

B. The Total Harmonic Distortion (THD) of the driver input current shall be no more than 20% when operating at nominal input voltage.

C. Drivers shall have a minimum Power Factor (PF) of 0.90.

D. Drivers shall comply with IEEE/ANSI C62.41 Category C2 (medium) for transient voltage protection. This shall include a 10kV rating, and 5kA rating per the standard 8x20us combo wave testing parameters.

E. Drivers shall comply with the requirements of the FCC rules and regulations, Title 47 CFR Part 18, Non-consumer (Class A) for EMI & EMF (conducted and radiated) interference.

F. Fixtures may require additional surge protection apart from what is integral with the LED driver. See Paragraph 2.8 below for more details.

2.6 LED BOARDS

A. Rated minimum life of 60,000 hours minimum per IES LM-70 testing requirements.

B. Provide a TM21 report on LED boards to be used which tests LED life and lumen maintenance per the IES LM-80 standard, and LED light output and efficacy per the IES LM-70 standard.

C. The correlated color temperature (CCT) of the LEDs shall be 4000K unless noted otherwise. The CCT shall be uniform for all LED modules within like luminaire types and luminaires within a given project. The LED CCT measurements shall have a maximum of three standard deviations (3 SDCM, +/-90K) tolerance on the MacAdam Ellipse.

D. Provide LED boards such that any individual LED failure on a section of LED board within the fixture will not result in significant output loss of the overall fixture.

2.7 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

A. Comply with UL 773 or UL 773A.

B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc (16 to 32 lx) and off at 4.5 to 10 fc (48 to 108 lx) with 15-second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.

1. Relay with locking-type receptacle shall comply with ANSI C136.10.
2. Adjustable window slide for adjusting on-off set points.

2.8 EXTERNAL LED DRIVER SURGE PROTECTION DEVICE (SPD)

A. All pole mounted LED light fixtures, and pole mounted outdoor sports lighting LED products shall come equipped with an additional layer of SPD protection. This additional protection shall be in addition to requirements of the surge protection integral to the LED driver itself.

B. The SPD shall be circuited immediately upstream of the LED driver and mounted either within the fixture or immediately adjacent to it in a concealed, protected, and accessible location. Do not void manufacturer warranty or listing requirements when mounting the SPD.

C. The external SPD shall be circuited either in series or parallel with the light fixture circuit as required of the project and Department needs. In series circuiting shall de-energize the fixture upon SPD failure (indicating a problem) while parallel circuiting shall allow for continued fixture use after SPD failure.

2.9 LUMINAIRE POLES

A. 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 assem-

bly plus luminaires at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of 70 mph with a gust factor of 1.3. Support assembly includes pole or other support structures, brackets, arms, appurtenances, base, and anchorage and foundation.

C. 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.

D. Round Tapered Steel Light Duty Pole: F The pole shaft shall be a 1-piece assembly conforming to ASTM A595 Grade A or A572 Grade 55 with a constant linear taper of 0.14 in/ft.

E. Handhole - A reinforced handhole with grounding provision shall be provided at 1'-6" from the base end of the pole assembly. Each handhole shall include a cover and the cover attachment hardware. Poles with a 5.90" base diameter shall be supplied with a 3" X 5" rectangular handhole. All other pole assemblies shall be provided with a 4" X 6.5" ovalized handhole.

F. Metal Pole Brackets: Match pole metal. Provide cantilever brackets without underbrace, in sizes and styles indicated, with straight tubular end section to accommodate luminaire.

G. Finish: Match finish of pole/support structure for arm, bracket, and tenon mount materials.

2.10 LUMINAIRE POLE FOUNDATIONS

A. Pole/Support Structure Bases: Anchor type with hold-down or anchor bolts, leveling nuts, and bolt covers.

B. Embedded type with underground conduit/cable entry.

C. Comply with Specification Section 03300- Cast-in-Place Concrete.

D. Design Strength: 3000-psig (20.7-MPa), 28-day compressive strength.

\PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.

C. Examine walls, roofs, canopy ceilings and overhang ceilings for suitable conditions where luminaires will be installed.

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

3.2 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is substantially complete, clean luminaires used for temporary lighting and install new lamps.

3.3 LUMINAIRE INSTALLATION

A. Install lamps in each luminaire.

B. Fasten luminaire to indicated structural supports. Additional support requirements include:

1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
2. Sized and rated for luminaire weight. Able to maintain luminaire position after cleaning and relamping.
3. Support luminaires without causing deflection of finished surface.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

C. Wall-Mounted Luminaire Support:
1. Attached to structural members in walls.

D. Wiring Method: Install cables in raceways. Conceal raceways and cables.

E. Install luminaires level, plumb, and square with finished grade unless otherwise indicated. Install luminaires at height and aiming angle as indicated on Drawings.

F. Coordinate layout and installation of luminaires with other construction.

G. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

H. Comply with requirements in Section 260519 “Conductors”, Section 260526 “Grounding System”, and Section 260533 “Raceways” for wiring connections and wiring methods.

3.4 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Section 260533 "Raceways" In concrete foundations, wrap conduit with 0.010-inch- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals.

3.6 FIELD QUALITY CONTROL

A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

B. Perform the following tests and inspections:
   1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
   2. Verify operation of photoelectric controls.

C. Illumination Tests:
   1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):
      a. IES LM-5.
      b. IES LM-50.
      c. IES LM-52.
      d. IES LM-64.
      e. IES LM-72.
   2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

D. Luminaire will be considered defective if it does not pass tests and inspections.

E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.7 DEMONSTRATION

A. Train the Department’s maintenance personnel to adjust, operate, and maintain luminaires and photocell relays.

3.8 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
   1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
   2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
   3. Adjust the aim of luminaires in the presence of the Architect and UNL Project Manager.

3.9 INSTALLATION OF INDIVIDUAL GROUND-MOUNTED LUMINAIRES

A. Aim as indicated per manufacturer’s aiming instruction.

END OF SECTION 26 56 19

SECTION 27 15 13

COPPER HORIZONTAL CABLING

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions to the Construction Contract”, “Special Conditions”, and “Division 01 – General Requirements” form a part of this Section by the reference thereto and shall have the same force and effects as if printed herewith in full.

1.2 SUBMITTALS

A. Product Data:

1. Product Datasheets.
2. Bill of Materials (BOM).
3. Warranty documentation, including connectivity/cabling manufacturer product warranty data and certificates of complete connectivity solution provider status for the Contractor.

B. Shop Drawings:

1. Floor Plans
2. Labeling Schema.

C. Closeout Submittals:

1. Product Datasheets.
2. As-Built Drawings:

    a. Floorplans
    b. Rack Elevations.
    c. Wall Elevations.
    d. Labeling Schema.

3. Field Quality Control / Test Results.
4. Cable and connectivity manufacturers’ certification of quality and performance.

    a. Warranty documentation, including cabling and connectivity manufacturers’ current product warranty data and certificates of complete connectivity solution provider status for the Contractor.
    b. Executed warranty documentation: Site specific, supplied from the manufacturer.

1.3 REFERENCES

A. Definitions:

1. Consolidation Point (CP): A location for interconnection between horizontal cables extending from Telecommunications Rooms and horizontal cables extending to the communications outlet/connector. Typically used to feed office furniture or similar re-configurable areas.
2. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
3. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications' outlet/connectors. Similar function as CP except the horizontal cables are terminated with RJ45 interfaces at both ends and the cable extends to the workstation as a station attachment cable.
4. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.
5. Twisted-Pair: Two individually insulated copper wires physically twisted together to form a balanced pair.
6. Twisted-Pair Cable: A multi-conductor cable comprising two or more copper conductors twisted in a manner designed to cancel electrical interference. Also called balanced twisted-pair cable.

B. Reference Standards:

1. TIA/EIA-568-C, including TIA/EIA-568-C.0, Generic Telecommunications Cabling for Customer Premises; TIA/EIA-568-C.1, Commercial Building Telecommunications Cabling Standard Part 1: General Requirements; TIA/EIA- 568-C.2, Balanced Twisted-Pair Telecommunications Cabling and Components Standard; and TIA/EIA-568-C.3, Optical Fiber Cabling Components Standard.
2. TIA/EIA-569-C, or most current version, Telecommunications Pathways and Spaces.
3. TIA/EIA-606-B, or most current version, Administration Standard for Commercial Telecommunications Infrastructure.
4. TIA/EIA-607-B, or most current version, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
5. The most current published version of the "Telecommunications Distribution Methods Manual (TDMM)" published by the Building Industry Consulting Services International (BICSI).
6. The most current published version of the "Information Transport Systems Installation Methods Manual (ITSIMM)" published by the Building Industry Consulting Services International (BICSI).

1.4 COORDINATION

A. Review and coordinate the sizes, quantity, routing and spacing of pathways to ensure they will adequately support the work of this Section.

1. Confirm that cables to be installed will not exceed maximum fill capacities of raceways and shall meet the minimum requirements of Local, State and Federal laws and requirements.

2. Confirm that cables to be installed within the pathways will not exceed the maximum standards-based distance limitations (90 meters (295 feet)) for horizontal cabling.

B. Coordinate communications outlet/connector locations with the location of power receptacles at each work area. Coordinate so that power receptacles are immediately adjacent and same height.

C. Coordinate layout and installation of communications cabling with telecommunications and LAN equipment and service suppliers.

1.5 QUALITY CONTROL

A. Field Quality Control Services including Testing and Inspections are the responsibility of the contractor.

B. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings**, Cabling Administration Drawings, and field-testing program development** by an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of **Level 2 Installer**, who shall be present at all times when Work of this Section is performed at Project site.
3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

b. Testing Agency Qualifications: An NRTL.

C. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

1.6 DELIVERY, STORAGE AND HANDLING

A. Store materials in conditions endorsed by the product manufacturer.

B. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

C. Do not deliver or install product(s) in conditions that jeopardize the performance or manufacturer life expectancy and service life of the product.

1.7 WARRANTY

A. Additional requirements: Cabling and connectivity products manufacturers, including patch cords, shall have in place an agreement recognizing each other for execution of the warranty as

specified. Performance and applications warranties shall be channel rated, including patch cords.

B. The cable manufacturer and the connectivity products manufacturer shall be the same manufacturer or shall have a partnership agreement established in order to provide the required warranty.

C. Required warranty: The TIA/EIA-568-C Category 6 – 250 MHz compliant cable system shall include a minimum 15 year extended product warranty and performance/applications assurance program to minimum of 5dB of crosstalk margin beyond the CAT 6 standard for NEXT, PSNEXT, ACR and PSACR**.**

1.8 SYSTEM DESCRIPTION

A. Horizontal cabling and connecting hardware provide the means of transporting signals between the communications outlet/connector and the horizontal cross-connect located in the communications room or enclosure. The cabling and associated connecting hardware are called a "permanent link," a term that is used in the testing protocols.

B. Provide TIA/EIA-568-C compliant 4-pair twisted pair horizontal cabling system.

1. Provide Category 6 compliant horizontal cabling system.

C. Cabling

1. Refer to the Drawings for types and quantities of horizontal cables.
2. Provide total connectivity for complete and permanent installed communications links.
3. The copper horizontal cabling system shall include provisions for voice/telephone, data/network, video surveillance, audio-visual, access control, building automation, control data and intrusion detection systems.

a. Cables may be color-coded by system. Reference the Drawings for requirements and coordinate with the Department for final verification.

D. Unless pre-approved by the Designer, provide a single, uniform and complete connectivity solution for this Section:

1. Cabling and connectivity for this Section, and related structured cabling Sections (used to form a unified Structured Cabling System), shall be provided by a single manufacturer or a two manufacturer formal relationship.

PART 2 - PRODUCTS

2.1 GENERAL

A. Products furnished of each Type shall be manufactured by a single manufacturer, bear the same brand name, be the same finish color and texture, and be from the same product model series, except where otherwise indicated.

2.2 CABLING

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

1. Berk-Tek; a Nexans company (Berk-Tek).
2. Belden CDT.
3. CommScope, Inc. (CommScope).
4. General Cable Technologies Corporation (General Cable).
5. Mohawk; a division of Belden CDT (Mohawk).
6. Superior Essex.

B. General:

1. General Performance: Comply with transmission standards in TIA/EIA-568-C when tested according to test procedures of this standard.

    a. Twisted pair cable is required to have the appropriate Category classification as defined by TIA/EIA-568-C. Compliance with these electrical characteristics shall be third party verified by the manufacturer.

2. System cables shall be code compliant, and UL/NEC rated for the location, manner, and environmental conditions in which the cables are installed.

    a. Cables that are installed in an air handling space and not installed in a totally enclosed pathway system shall be UL plenum rated.
    b. Cables used for below grade applications, and cables used in pathways that may reasonably end up with standing water within them, shall be manufacturer rated for continuous contact with water without performance degradation or compromise in warranty.
        1) Cables in conduit to a floorbox in a slab on grade application shall transition to OSP rated 4 pair cables.
    c. Cables used for direct burial, aerial, or other applications shall be manufacturer rated for the application.
        1) Also see “Inter-Building Cabling” Section for cable alternate construction.

3. Cables on this Project may be color-coded. See drawings for color code.

C. Twisted Pair Cable

1. Description: 100-ohm, Indoor four-pair with a thermoplastic jacket.

   a. Comply with ICEA S-90-661 for mechanical properties.
   b. Comply with TIA/EIA-568-C for performance specifications.
   c. Comply with TIA/EIA-568-C, Category 6.
      1) Cable shall have two individual insulated 23 AWG solid copper conductors formed into a twisted pair.
      2) Cable shall be constructed of one 4-pair bundle of individually insulated Unshielded Twisted Pairs (UTP).
      3) Minimum of 5dB of crosstalk margin beyond the CAT 6 standard for NEXT, PSNEXT, ACR and PSACR.
      4) Basis of design shall be: General Cable GenSpeed 6000

2.3 CABLE TERMINATION HARDWARE

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

1. CommScope, Inc. (CommScope).
2. Hubbell Premise Wiring (Hubbell).
3. Leviton Mfg. Company, Inc. (Leviton).
4. Ortronics; a subsidiary of Legrand (Ortronics).
5. Panduit Corp. (Panduit).
6. 3M (Transition splices)

B. General Requirements for Cable Connecting Hardware:

1. Comply with TIA/EIA-568-C, IDC type, with modules designed for punch-down.
2. Cables shall be terminated with connecting hardware of same category or higher.
3. Provide one single manufacturer for twisted pair termination hardware used together in a permanent link and whenever a Category certification is required.
4. Cable hardware (i.e., connectivity) shall be part of the manufacturer's enterprise solution.
5. Cable hardware shall be component rated with third-party verification for the specified Category-rated component compliance.

C. Patch Panels

1. Modular panels housing multiple-numbered in-line configured IDC terminations for permanent termination of pair groups of installed cables.

   a. Provide panels in quantities sufficient to terminate each 4 pair UTP cables as indicated on the Drawings.

b. Comply with TIA/EIA-568-C, Category 6.
   1) Flat patch panel.
   2) UL listed.
   3) Black steel with PCB connection between interfaces.
   4) Labeling areas on front and rear.
   5) Mountable in EIA standard 19-inch rack/cabinet rails.
   6) 24-ports in 1.75 inches of rack space (1 RU); 48-ports in 3.5 inches of rack space (2RU).
   7) RJ45 (8P8C) jack interface on front and 110-style IDC connections on rear.
   8) Tested and verified to meet TIA component, permanent link and channel requirements.
   9) Provide accessory strain relief bars on the rear with hook and loop ties.
   10) Basis of Design Flat: Panduit DP**688TGY

D. Connector Jacks, Jack Assemblies

1. Connector Jacks:

   a. 100-ohm, balanced, twisted pair connector; four-pair, eight-position modular color-coded receptacle units with integral IDC-type terminals, component rated.
      1) Category 6 Modular Jack: Basis of Design shall be Panduit CJ688TG**.

   b. Connector jacks and jack assemblies shall be color coded by system.
      1) Color(s): As scheduled in the Contract Documents.

2.4 SOURCE QUALITY CONTROL

A. System components shall be tested and listed by one or more United States NRTL.

PART 3 - EXECUTION

3.1 GENERAL

A. Review and coordinate cabling pathways prior to pathway and cabling installation.

1. Coordinate to resolve deviations, defects or other problems with pathways prior to installation. Allow adequate time for corrections so as to avoid delays to the Project completion date.
2. Provide additional or supplemental TIA/EIA-569-C compliant pathways and cable support where required. Provide additional sleeves through walls/floors/ceilings, as necessary to route cables within buildings.

B. Project Conditions

1. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Do not deliver or install product(s) in conditions that jeopardize the performance or manufacturer life expectancy and service life of the product.
3. Delivery, Storage and Handling

    a. Store materials in conditions endorsed by the product manufacturer.

C. Compliance

1. Comply with NECA 1.
2. Comply with TIA/EIA-568-C, including TIA/EIA-568-C.0, Generic Telecommunications Cabling for Customer Premises; TIA/EIA-568-C.1, Commercial Building Telecommunications Cabling Standard; TIA/EIA-568-C.2, Balanced Twisted-Pair Telecommunication Cabling and Components Standard; and TIA/E7IA-568-C.3, Optical Fiber Cabling Components Standard.
3. Monitor cable pull tensions, and comply with BICSI ITSIMM, Chapter “Pulling Cable.”
4. Comply with BICSI ITSIMM, Chapter “Cable Termination Practices.”
5. Comply with requirements for raceways and boxes specified in Section 270528 “Pathways for Communications.”

    a. Comply with TIA/EIA-569-C, or most current version, for pull-box sizing and length of conduit and number of bends between pull points.
    b. Do not exceed the required fill capacity of raceways.

6. Install faceplates and inserts furnished under Section 271543 “Faceplates and Connectors” and/or Section 271544 “Custom Faceplates, Panels and Connectors."
7. Provide the appropriate cable rated for the environmental conditions in which the cable is to be installed.

3.2 INSTALLATION OF CABLES

A. Prior to procurement and installation of the horizontal cabling system, coordinate and verify pathways provided and indicated on the Contract Documents.

1. Coordinate and verify to ensure that horizontal cables will not exceed the maximum standards-based distance limitations (90 meters (295 feet)) for horizontal cabling. Any discrepancy shall be immediately brought to the attention of the Designer for direction.
2. The maximum allowable total channel distance is 328 feet (100m) between equipment in the communications room and station equipment, including cable service loops, patch cables and station attachment cables.
3. If proactive steps are not taken prior to procurement or installation, the Contractor shall be responsible for costs associated with providing the horizontal cabling system within

industry-standard distance limitation parameters, including, but not limited to, additional required cabling, pathways, rough-in, equipment, communications rooms or enclosures, power and cooling requirements.

B. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the communications outlet/connector.

C. Bridged taps and splices shall not be installed as part of the horizontal cabling.

D. Install cables within approved pathways. Install cables that are not otherwise required to be installed within raceway in such manner as to conceal them from view. Conceal conductors and cables in accessible ceilings, walls and floors.

E. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.

F. Do not splice cable between terminations or junction points. Cable runs shall be continuous. Wiring shall be free from grounds, shorts, opens and reversals.

G. Maintain complete protection of cabling. Cabling shall not be left hanging or coiled where it potentially obstructs the Work of other trades.

H. Cable routing shall follow building structure lines (parallel and perpendicular).

I. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.

J. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used for heating.

K. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in communications spaces with terminating hardware and interconnection equipment.
2. Suspend cable not in a raceway, a minimum of 8 inches (200 mm) above ceilings by discrete cable supports not more than 60 inches (1524 mm) apart. Bridle rings are not permitted.
3. Cable shall not be run through structural members or in contact with conduits, pipes, ducts or other similar or potentially damaging items.

L. Provide conduit sleeves for penetrations.

1. Provide conduit sleeves for cables where cables pass through walls, floors and ceilings.
2. Patch and firestop around sleeves.
3. Firestop the interior of the sleeves after cable installation.
4. Provide the appropriate bushings on each end. Split bushings shall not be used.
5. Provide waterproof sealant for penetrations in humidity controlled areas.

M. Maintain (do not violate) the minimum bend radius specified by the manufacturer of the cable.

N. At final termination, excess cable and the service loop shall be supported and stored neatly in the cable tray or ladder rack within the communications room and above the ceiling line at an accessible point at the station end.

O. Proper strain relief shall be applied to cables after installation to lessen the risk of physical damage and to provide proper aesthetic value.

P. Cabling within Enclosures:
   1. Bundle, lace, and train cables within enclosures.
   2. Connect to terminal points with no excess and without exceeding manufacturers' limitations on bending radii.
   3. Provide and use lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.

Q. Comply with requirements in Section 270501 "Basic Materials and Methods for Communications."

   1. Bundle cables within racks, ladder racks, cable trays and in discrete cable supports. Utilize reusable cable bundling hardware. Utilize plenum-rated hardware in plenum spaces.

R. Separation from EMI Sources:

   1. Outlet requirements where power and communications must be co-located, a voltage barrier shall be provided.
   2. Comply with BICSI TDMM and TIA/EIA-569-C recommendations for separating unshielded twisted pair (UTP) cable from potential EMI sources, including electrical power lines and equipment.
   3. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

      a. Electrical Equipment Rating Less Than 2kVA: A minimum of 5 inches (127 mm).
      b. Electrical Equipment Rating between 2 and 5kVA: A minimum of 12 inches (300 mm).
      c. Electrical Equipment Rating More Than 5kVA: A minimum of 24 inches (610 mm).
   4. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
      a. Electrical Equipment Rating Less Than 2kVA: A minimum of 2-1/2 inches (64 mm).
      b. Electrical Equipment Rating between 2 and 5kVA: A minimum of 6 inches (150 mm).
      c. Electrical Equipment Rating More Than 5kVA: A minimum of 12 inches (300 mm).
   5. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
      a. Electrical Equipment Rating Less Than 2kVA: No requirement.

b. Electrical Equipment Rating between 2 and 5kVA: A minimum of 3 inches (76 mm).
c. Electrical Equipment Rating More Than 5kVA: A minimum of 6 inches (150 mm).

6. Separation between Communications Cables and Electrical Motors and Transformers: A minimum of 48 inches (1200 mm).
7. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

S. Separate cabling by service and type (i.e., voice, data, control, coaxial, fiber) prior to terminating.

1. Color coding of cable and termination devices shall be coordinated and approved prior to procurement and installation.
2. Terminate cabling on specified termination hardware in alpha-numerical order.
3. Group connecting hardware for cables into separate logical fields.
4. Neatly dress and securely attach cabling to the backboard and/or cabinet/rack.
5. Provide adequate cable lengths to reach any location on the backboard or within the cabinet/rack.
6. Bundle and support cables of this System separately from the cables of other systems.
7. Maintain separation between cables carrying different signal types and different signal levels.

a. Where cables from different systems or cables with different signal types are expressly permitted by the Designer to share a common pathway, each of these cable groups shall be kept segregated to the maximum degree physically possible. Cables from different systems shall not be mixed or intertwined.

T. Service loop:

1. Within communications rooms, provide a minimum service loop of 10 feet (3 m) , and spool the service loop in the ladder rack.
2. At the outlet/connector, provide a minimum service loop of 2 feet (0.6096 m) , and spool and store within a discrete cable support (J-hook) above the accessible ceiling at the outlet/connector location.

U. Cable Termination:

1. Terminate every conductor; no cable shall contain unterminated elements unless otherwise indicated. Make terminations only at indicated outlets, terminals, cross-connects and patch panels.
2. Utilize standard positive identification color coding for multi-conductor cables.
3. Provide 110-style IDC termination hardware unless otherwise indicated.

a. Do not untwist twisted pair cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

4. Cables from the same room/space shall be terminated adjacent on termination hardware. Cables from outlets/connectors shall be terminated in alpha-numeric, sequential order, based on final room numbers.

a. If the communications room serves more than one floor, in addition to the requirements identified above, sequentially group the cables, by floor, on separate patch panels.

3.3 IDENTIFICATION

A. Label cables and other components in compliance with Section 270553 “Identification for Communications” for labeling requirements.

B. Label each end of the cable.

C. Identify system components and cabling in compliance with TIA/EIA-606-B, or most current version.

3.4 FIELD QUALITY CONTROL

a. Testing Agency: **Engage** a qualified testing agency to perform tests and inspections.

B. Comply with Section 270810 “Verification Testing of Structured Cabling”.

C. Perform tests and inspections.

1. Twisted pair cabling shall be factory tested according to TIA/EIA-568-C.
2. Visually inspect twisted pair jacket materials for NRTL certification marking. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-C.
3. Visually confirm the required Category-rated marking of cables, outlets, cover plates, outlets/connectors, patch panels and other termination hardware.
4. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords and labeling of components.
5. Test twisted pair copper cabling for DC loop resistance, shorts, opens, intermittent faults and polarity between conductors.

    a. Test instruments shall meet or exceed applicable requirements in TIA/EIA- 568-C. Perform tests with a tester that complies with performance requirements in “Test Instruments (Normative)” Annex, complying with measurement accuracy specified in “Measurement Accuracy (Informative)” Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

6. UTP Performance Tests:

    a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-C and 270810 “Verification Testing of Structured Cabling.”
    b. Test cables through a Consolidation Point from workstation to patch panel.

7. Final Verification Tests: Perform verification tests for twisted pair systems after the complete communications cabling and workstation outlet/connectors are installed.
8. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report for the cables as well as a detailed report for each cable tested.
9. Remove and replace cabling where test results indicate they do not comply with specified requirements. Retest cabling and provide documentation.
10. End-to-end cabling shall be considered defective if it does not pass tests and inspections.
11. Prepare and submit test and inspection reports.

D. The Department reserves the right to have a representative present during testing procedures. Verification testing of copper may be performed at or near Project completion by the Consultant for quality assurance.

END OF SECTION 27 15 13

SECTION 311000
SITE CLEARING

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions of the Construction Contract”, “Special Conditions”, and “Division 1 - General Requirements” form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping or sealing, and removing site utilities.
7. Temporary erosion- and sedimentation-control measures.

1.4 DEFINITIONS

A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow.

D. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.

E. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.

F. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and indicated on Drawings “to remain”.

G. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.5 MATERIAL OWNERSHIP

A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Client Agency's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.6 INFORMATIONAL SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs or videotape.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.7 QUALITY CONTROL

A. Preinstallation Conference: Conduct conference at Project site.

1.8 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Client Agency and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Client Agency or authorities having jurisdiction.

B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Client Agency's premises where indicated.

C. Utility Locator Service: Notify One Call for area where Project is located before site clearing.

D. Do not commence site clearing operations until temporary erosion- and sedimentation-control measures are in place.

E. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.

2. Parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

F. Do not direct vehicle or equipment exhaust towards protection zones.

G. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

H. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly identify trees, shrubs, and other vegetation to remain. Flag each tree trunk at 54 inches above the ground.

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Client Agency.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.

B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

A. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Engineer.

3.4 EXISTING UTILITIES

A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed.

1. Arrange with utility companies to shut off indicated utilities.
2. Client Agency will arrange to shut off indicated utilities when requested by Contractor.

B. Locate, identify, and disconnect utilities indicated to be abandoned in place.

C. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Client Agency or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Engineer not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Engineer's written permission.

D. Excavate for and remove underground utilities indicated to be removed.

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
2. Grind down stumps and remove roots, obstructions, and debris to a depth of 18 inches below exposed subgrade.
3. Use only hand methods for grubbing within protection zones.
4. Chip removed tree branches and dispose of off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to depth of 6 inches in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects more than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

1. Limit height of topsoil stockpiles to 35 feet.
2. Do not stockpile topsoil within protection zones.
3. Stockpile surplus topsoil to allow for respreading deeper topsoil.
4. Straw mulch and seed.

3.7 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Client Agency's property.

B. Excess suitable soil should be taken to existing stockpile on Client Agency’s property as shown on plans (requires the installation of stone haul road).

C. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 311000

SECTION 312000
EARTHWORK

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions of the Construction Contract”, “Special Conditions”, and “Division 1 - General Requirements” form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Subgrade preparation, excavating, backfilling, and compaction.
B. Contractor shall pay for services of a testing agency.

1.3 REFERENCES

A. Geotechnical Engineering Report – Not available.

B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
1. D 1557 Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3.)).
2. D 2216 Laboratory Determination of Water (Moisture) Content of Soil, and Rock.
3. D 2487 Classification of Soils for Engineering Purposes (Unified Soil Classification System).
4. Commonwealth of Pennsylvania, Department of Transportation, Specifications, Publication 408 (PENNDOT 408).

1.4 SUBMITTALS

A. Material Test Reports:
1. Classification according to ASTM D 2487 of each on-site or borrow soil material proposed for fill and backfill.
2. Laboratory compaction curve according to ASTM D 1557 for each on-site or borrow soil material proposed for fill and backfill; provide for each material type and for every 5,000 cubic yards of each material.

1.5 QUALITY CONTROL TESTING

A. The Contractor shall perform all necessary Quality Control tests and procedures for the performance of the work, in accordance with Section 014000 and this section, to produce end results specified. The Contractor’s Quality Control Agent shall maintain clear and orderly records of such tests and procedures and make them available for field review and approval of the Professional and the Department. The Contractor’s bid shall include the cost of all Quality Control tests and inspections.

B. The Contractor shall submit its plan for Quality Control testing to the Professional and the Department for review and comments. The Professional shall consult with its Quality Assurance Agent in arriving at its opinion.

C. Quality Control tests shall include tests on fill material, optimum moisture content and maximum density and field density tests of fill layers. The Quality Control Agent shall comment on the suitability of all subgrades, and the subgrades shall be acceptable to the Consulting Geotechnical Engineer.

D. Handwritten copies of filed test reports shall be provided to the Contractor. They shall be given to the Contractor and Assistant Project Coordinator (APC) within two (2) hours of completion, but in no event shall the technician leave the site without providing the Contractor and APC with a copy of the test results. This shall include density, % moisture, plan location, elevation, comments and any other relevant data. Comments shall include any condition that might have adverse effect on the operations, including weather, drainage, etc.

E. The Contractor shall request consultation with the Consulting Geotechnical Engineer on any problems that arise during construction. Copies of the daily in-place soil density tests shall be faxed to the consultant by the Contractor through the testing agency within twenty-four (24) hours of the time the tests are made.

F. The Contractor shall approve each subgrade and each fill layer before proceeding to the next layer. Any area which does not meet density, % moisture or other requirements at any time, shall be suitably reworked and retested by the Contractor at his own expense.

G. The Professional and/or the Department will perform all Quality Assurance Testing and Inspection Services deemed necessary for the assurance of the Professional and/or the Department. This does not relieve the Contractor of his responsibilities. The Department will bear the cost of Quality Assurance tests and inspections.

1.6 DEFINITIONS

A. Degree of Compaction: Degree of compaction required is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 abbreviated hereinafter as percent laboratory maximum density. For granular material, relative density is determined in accordance with ASTM D 4254.

B. Hard Material: Weathered rock, dense consolidated deposits, or buried construction debris (i.e., demolished brick walls, concrete, etc.) which are not included in the definition of “rock” but which usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

C. Rock: Rock material in beds, ledges, unstratified masses, and conglomerate deposits and boulders of rock material exceeding 1 cubic yard. for bulk excavation or 3/4 cubic yard that cannot be removed by rock excavating equipment without systematic drilling, ram hammering, ripping.

D. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below base or topsoil materials.

E. Subbase: Material shown on the Drawings between the pavement base and subgrade.

1.7 REGULATORY COMPLIANCE

A. Codes and Standards: Perform earthwork complying with federal, state, and local regulations including the Occupational Safety and Health Act of 1970 as amended. Excavation and trenching are regulated by OSHA. The Contractor shall perform all excavation and trenching work in accordance with 29 CFR 1926 Subpart P.

1.8 PROJECT CONDITIONS

A. BASIS OF CONTRACT

1. Excavation for this Project shall be considered unclassified and shall include all types of earth and soil, any pebbles, boulders, and bedrock, municipal trash, rubbish and garbage and all types of debris of the construction industry such as wood, stone, concrete, plaster, brick, mortar, steel and iron shapes, pipe, wire, asphaltic materials, paper and glass. Unclassified excavation does not include unforeseen concrete foundations, walls, or slabs. All such materials encountered which are identified by this paragraph as unclassified shall be removed to the required widths and depths to create a finished product as shown and/or noted on the drawings and as written in the specifications. No additional compensation shall be made to the contractor for this unclassified excavation. The materials defined by this paragraph as unclassified will not be considered to be concealed conditions or unknown physical conditions below the surface of the ground for purposes of interpreting the language in the General Conditions of the Construction Contract.

B. Utility Identification: Notify PA One-Call System at 1-800-242-1776 at least 15 days prior to excavation.

C. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

D. Existing improvements, adjacent property, and other facilities and trees and plants that are not to be removed shall be protected from injury or damage, which may result from Contractor’s operation.

1.9 APPROVAL OF BEARING STRATA

A. The Contractor shall furnish adequate advance notification to the Department and the Professional of times when footing excavations or paving subgrades are to be completed, so that the Construction Stage Geotech Quality Assurance Agent can verify that the bearing quality of the soil has been properly inspected and/or tested by the Contractor. Formwork and concreting shall follow only after approval by the Construction Stage Geotech Quality Assurance Agent.

B. Should the bearing at the levels indicated be found by the Professional and the Department to be inadequate, they may order the excavation carried down to sound bearing. Such excavation shall be classed as additional work and payment be made on the basis of an agreed price according to the General Conditions. Should suitable bearing be found at a lesser depth than indicated, the Professional and the Department may order the reduction of exaction specified or shown on the drawings, and the Contractor shall allow a credit for excavation thus omitted on the same basis.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil or suitable backfill materials are not available from excavations. Material must meet the definition of clean fill as defined by the Pennsylvania Department of Environmental Protection (PADEP).

B. Satisfactory Soil Materials: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP and SM or a combination of these group symbols.

1. Low plasticity (plasticity index less than 10).
2. Maximum particles size of 2-inches in any direction for areas of structural fill beneath asphalt paving, concrete sidewalk & slabs, curbs, and equipment pads. Maximum particles size of 6-inches in any direction for areas of fill under all landscaped areas.
3. Less than 2 percent deviation from optimum moisture content, as determined by ASTM D-1557, for areas of structural fill beneath asphalt paving, concrete sidewalk & slabs, curbs, and equipment pads. Less than 5 percent deviation from optimum moisture content, as determined by ASTM D-1557, for areas of fill under all landscaped areas.

C. Unsatisfactory Soil Materials: ASTM D 2487 soil classification groups GC, SC, CL, ML, OL, CH, MH, OH and PT, or a combination of these group symbols, or materials not conforming to the requirements for satisfactory soils, including:

1. Unsatisfactory soils also include satisfactory soils not maintained within 3 percent of optimum moisture content at time of compaction.
2. Debris, waste, frozen materials, vegetation and other deleterious matter.
3. Otherwise not meeting the requirements for satisfactory soil materials.
4. Materials containing excessive amounts of deleterious materials including construction debris, wood, glass, ash, or organic material as determined by the Department or Professional.

D. Backfill and Fill Materials: Satisfactory soil materials.

E. Structural Fill: Satisfactory soil materials.

F. Base Course: 2A coarse aggregate, Type C or better, as specified in PENNDOT 408, Section 703 - Aggregate. Material must meet the definition of clean fill as defined by PADEP. Recycled crushed concrete or bricks will not be allowed.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect existing utilities, sidewalks, structures, pavements, and other facilities to remain.

B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust. Refer to Erosion and Sedimentation Control drawings and Pennsylvania Code Chapter 102.

3.2 EXPLOSIVES

A. Explosives: The use of explosives is prohibited on this Project.

3.3 UNAUTHORIZED EXCAVATION

A. Unauthorized excavations shall be filled with satisfactory fill materials and compacted in accordance with the relevant paragraphs of this Section.

B. The Contractor is responsible for furnishing all materials, labor, supervision, tools, equipment, tools associated with unauthorized excavations without additional compensation.

3.4 MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.

3.5 COMPACTION OF BACKFILLS AND FILLS

A. Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment (e.g. ten-ton heavy duty roller), and not more than 4 inches in loose depth for material compacted by hand-operated tampers (e.g. jumping jack or walk behind roller).

B. Compact soil to not less than the following percentages of maximum dry unit weight according ASTM D-1557:

1. Under paving, slabs, sidewalks, equipment pads, and foundations, soils shall be compacted to at least 95% of the maximum dry density as determined by ASTM D-1557.
2. Under landscaped areas, soils shall be compacted to 90% of the maximum dry density as determined by ASTM D-1557.

3.6 GRADING

A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes.

3.7 SUBBASE AND BASE COURSES

1. Under pavements and walks outside the right-of-way, place base course on prepared subgrade.

3.8 PROTECTION

A. Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Provide fencing, barricades, and/or protective barriers for all excavation.

3.9 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off site to a regulated and permitted facility. Provide two copies of load manifest and permit from Client Agency of the property where material is deposited.

END OF SECTION 322000

SECTION 321216
ASPHALT PAVING

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions of the Construction Contract”, “Special Conditions”, and “Division 1 - General Requirements” form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. This section includes furnishing all labor, equipment, and materials for the installation and testing of bituminous paving and patching of pavements surfaces.

1.3 REFERENCES

A. Commonwealth of Pennsylvania, Department of Transportation (PENNDOT)
   1. Bulletin No. 15: Approved Construction Materials

B. Asphalt Institute (AI): “The Asphalt Handbook”

C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

   1. ASTM D 692: Standard Specification for Coarse Aggregate for Bituminous Paving Mixtures
   2. ASTM D 2950: Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods

1.4 SUBMITTALS

A. Product Data: For each product specified. Include technical data and tested physical and performance properties.

B. Obtain materials from the same source throughout.

1.5 PROJECT CONDITIONS

   1. Environmental Limitations: Do not apply asphalt materials if substrate is wet or excessively damp.

PART 2 - PRODUCTS

2.01 AGGREGATES

A. Coarse Aggregate: Sound, angular crushed stone; crushed gravel; complying with ASTM D 692.

B. Fine Aggregate: Sharp-edged natural sand or sand prepared from stone; gravel, complying with ASTM D 1073.

2.02 ASPHALT MATERIALS

A. Asphalt Binder: ASTM D6373 binder designation PG 64-22.

B. Tack Coat: Emulsified asphalt, E-8 during paving season, factory diluted in water, of suitable grade and consistency for application.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to support paving and imposed loads.
B. Flexible pavement courses shall be installed in accordance with PENNDOT Publication 408, Section 400.

C. Tack Coat

1. Application of tack coat shall be in accordance with PENNDOT 408 Section 460.

3.02 INSTALLATION TOLERANCES

A. Thickness: Compact each course to produce the thickness indicated on the Drawings within the following tolerances:

1. Base Course: Plus or minus ½ inch.
2. Binder Course: Plus or minus ¼ inch.
3. Wearing Surface Course: Plus ¼ inch, no minus.

3.10 CLEANUP

A. Remove bituminous material from utility structure frames and covers. Open and reset utility manhole covers and inlet grates to ensure castings are not sealed shut.

B. Clean up debris and unused material, and remove from the site. Dispose of all material in accordance with local, state, and federal regulations. Do not dump material in manholes or inlets.

END OF SECTION 321216

SECTION 321313

SITE CONCRETE

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions of the Construction Contract”, “Special Conditions”, and “Division 1 - General Requirements” form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. This Section includes the following:

1. Concrete sidewalks.
2. Concrete curbs.
3. Concrete testing and inspection.

1.3 REFERENCES

A. The most current version of the publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

B. Commonwealth of Pennsylvania, Department of Transportation, Specifications, Publication 408, (PENNDOT 408), except that measurement and payment sections do not apply.

1.4 SUBMITTALS

A. General: Submit each item in accordance with the General Requirements and Conditions of the Contract documents.

B. Product Data: For each type of manufactured material and product indicated.

C. Design Mixes: For each concrete pavement mix and class. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

1.5 QUALITY CONTROL

A. Installer Qualifications: An experienced installer who has completed pavement work similar in material, design, and extent to that required for this Project and whose work has resulted in construction with a record of successful in-service performance.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, type IA.

B. Normal-Weight Aggregates: ASTM C33, Class 4S, uniformly graded. Provide aggregates from a single source.

C. Air-Entraining Admixture: ASTM C260/C260M.

D. Water: Potable and complying with ASTM C94/C94M.

2.2 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Fabric: ASTM A1064, fabricated from as-drawn steel wire into flat sheets.

B. Joint Dowel Bars: ASTM A 615, Grade 60. Cut bars true to length with ends square and free of burrs.

C. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

2.3 RELATED MATERIALS

A. Expansion-and-Isolation-Joint-filler-Strips: PENNDOT 408, Section 705.1.

B. Joint Sealer: In accordance with Pennsylvania Department of Transportation Publication 408, Section 705.4.

2.4 CONCRETE MIXES

A. Prepare design mixes, proportioned according to PENNDOT Publication 408, for each type and strength of concrete.

1. Slump Upper / Maximum Limit:
    a. Mix without water reducing admixtures: 5 inches
    b. Mix with water reducing admixtures: 6-1/2 inches
    c. Mix with high range water reducing admixtures (superplasticizers): 8 inches

2.5 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94. Furnish batch certificates for each batch discharged and used in the Work.

B. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
1. Air Content: 6 percent plus or minus 1-1/2 percent.

C. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

2.6 CONCRETE CURB

1. Concrete curb shall be in accordance with PENNDOT Publication 72M, Standards for Roadway Construction, RC-64M, latest edition.

PART 3 - EXECUTION

3.1 PREPARATION

A. Compact subgrade as indicated in Section 312000. Proceed with pavement only after nonconforming conditions have been corrected and subgrade and base course are stable and ready to receive pavement. Subgrade shall be in a moist condition when concrete is placed.

3.2 STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for fabricating reinforcement and with recommendation in CRSI's "Placing Reinforcing bars" for placing and supporting reinforcement.

3.3 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes.

3.4 FLOAT FINISHING

B. General: Do not add water to concrete surfaces during finishing operations.

C. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.

3.5 FIELD QUALITY CONTROL TESTING

A. Testing Laboratory: As part of this contract the Contractor shall retain the services of an

independent testing and inspection laboratory meeting the qualifications of paragraph 1.5.C to sample materials, perform tests and prepare and submit reports during concrete placement.

B. Testing Services: Testing shall be performed according to the following requirements:

1. Sampling Fresh Concrete: Representative samples of fresh concrete shall be obtained according to ASTM C 172, except modified for slump to comply with ASTM C 94.
2. Air Content: ASTM C 231, pressure method; one test for each compressive-strength test, but not less than one test for each day's pour of each type of air-entrained concrete.

C. Test results shall be reported in writing to the Department and Professional, concrete manufacturer, and Contractor, within 24 hours of testing.

D. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by the Department and Professional but shall not be used as the sole basis for approval or rejection.

3.11 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:
1. Elevation: 3/4 inch.
2. Thickness: Plus 3/8 inch minus 1/4 inch.
3. Surface: Gap below 10-feet-long; unleveled straightedge not to exceed 1/2 inch.
4. Joint Spacing: 3 inches.
5. Contraction Joint Depth: Plus 1/4 inch, no minus.
6. Joint Width: Plus 1/8 inch, no minus.

3.12 REPAIRS AND PROTECTION

A. Remove and replace concrete pavement that is broken, damaged, or defective, or does not meet the requirements in this Section. Concrete sections shall be removed to the nearest regularly spaced joint.

B. Repair Surface Defects in accordance with ACI 301.

END OF SECTION 321313

SECTION 321723

PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions of the Construction Contract”, “Special Conditions”, and “Division 1 - General Requirements” form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section includes painted markings applied to asphalt and concrete pavement.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Aexcel Inc.
2. Ennis-Flint.
3. Sherwin-Williams Company (The).
4. Transpo Industries, Inc.

2.2 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design".

2.3 PAVEMENT-MARKING PAINT

A. Pavement-Marking Paint: MPI #32, solvent-borne traffic-marking paint.

1. Color: White, Yellow, or Blue as indicated on the plan.

B. Pavement-Marking Paint: MPI #97, latex traffic-marking paint.

1. Color: White, Yellow, or Blue as indicated on the plan.

PART 3 - EXECUTION

3.1 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow paving to age for a minimum of 30 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils. Apply paint so that it cannot run beneath stencil.

END OF SECTION 321723

SECTION 32 31 11

GATE OPERATORS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions to the Construction Contract”, “Special Conditions”, and “Division 01 – General Requirements” form a part of this Section by the reference thereto and shall have the same force and effects as if printed herewith in full.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

A. Section Includes:

1. Gate Operators.

1.4 SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Shop Drawings: Illustrate products, installation, and relationship to adjacent construction. Provide wiring diagrams and details of the installation including the keypads, the loop sensor, photoelectric and edge sensors, and the operator.

2. Product Data: Manufacturer’s descriptive data and product attributes.

C. Closeout Submittals:

1. Operation and Maintenance Data.

1.1 QUALITY CONTROL

A. Field Quality Control Services including Testing and Inspections are the responsibility of the contractor.

B. Installer Qualifications: Firm specializing in the work of this Section, with minimum 4 years' experience. Shall be provided a certified installer approved by the manufacturer.

1.2 WARRANTY

A. Manufacturer's 7 year warranty against material and manufacturing defects.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Contract Documents are based on products by LiftMaster. Provide LiftMaster or approved equal.

B. Hoover Fence Company

C. Eagle Access Control Systems

2.2 MANUFACTURED UNITS

A. Slide Gate Operator:

1. Model: CSL24UL.
2. Operation: Gear driven.
3. Meet UL 325, UL 991, ASTM F2200, and CAS C22.2 No. 247.
4. Motor: 24 VDC, continuous duty type, sized to gate conditions.
5. Traveling speed: 12 inches per second.
6. Battery backup: 33Ah.
7. Keypad: Dual-height keypad mounted pedestal, 42" and 72", in 2"x2" square post, black powder coated, weather resistant finish. Provide lift master PED4272 or approved equal.
8. Monitoring and controls:
    a. Internet connectivity: MyQ technology with 50 channel FHSS.
    b. Built-in Wi-Fi with internet gateway.
    c. Radio receiver: Security+ 2.0 technology.
    d. Monitored retro-reflective photo eyes.
    e. Monitored small profile wired safety edge.
9. Accessories:
    f. Monitored safety devices: Photo eyes, monitored edge.
    g. Wired monitored edges: Monitored edge.
    a. Plug-in loop detector.
    b. Wireless commercial keypad.
    c. One button encrypted DIP remote control.

d. Internet gateway.
e. Smart video intercom.
f. Commercial access control receiver.
g. Passport receiver with Security+ 2.0 technology.
h. Passport one-button [mini] remote.
i. Heater kit.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store gate controls equipment in a place not affected by the weather.

B. Examine gate control before installation. Reject equipment that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive equipment for compliance with installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION

A. Install gate controls in accordance with manufacturer’s instructions.

B. Provide Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Electrical Identification."

3.3 FIELD QUALITY CONTROL

A. Testing Agency: **Engage** a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

E. Tests and Inspections:

1. Inspect gate controller, wiring, components, connections, and equipment installation. **Test and adjust controllers, components, and equipment.**
2. Test insulation resistance for each controller element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.
4. Perform each electrical test and visual and mechanical inspection stated in manufacturer recommendations. Certify compliance with test parameters.
5. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
6. Test and adjust controls, safety devices, and operation of the controller with the gate. Check proper operation of the gate. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

A. Adjust moving parts and operable component to function smoothly and lubricate as recommended by manufacturer.

B. Test and adjust operators for proper operation.

3.5 DEMONSTRATION AND TRAINING

A. Demonstration: Demonstrate operation and programming of operators to maintenance and operation personnel.

B. Training: Provide training in the adjustment, operation, and maintenance of the gate to the operation and maintenance personnel. Provide minimum 4 hours of training. The training shall be performed by the manufacturer or by an authorized agent.

END OF SECTION 32 31 11

SECTION 323113
CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions of Contract”, “Special Conditions” and “Division 1 - General Requirements” form a part of this section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. This work required under this section consists of furnishing all labor, materials, equipment, services, and related items necessary to complete all the temporary chain link fencing work as indicated on the Drawings and described in the specifications.

1.3 SUBMITTALS

A. Shop Drawings: Layout of fences with dimensions, details, and finishes of components, accessories, and post foundations.

B. Product Data: Submit manufacturer’s technical data and installation instructions for metal fencing, fabric, and accessories.

1.4 QUALITY CONTROL

A. Provide chain link fences from a single source including necessary erection accessories, fittings, and fastenings.

B. Perform work in compliance with applicable requirements of governing authorities having jurisdiction.

C. All material specified herein shall be full weight and first class in every respect. All fittings necessary to produce a complete installation shall be included even though not specifically mentioned.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Products shall be supplied from qualified manufacturers having a minimum of five years' experience manufacturing galvanized coated chain link fencing and shall meet the following specifications for design, size, gauge of metal parts and fabrication.

2.02 CHAIN LINK FENCE FABRIC

A. Size: Helically wound and woven to height as indicated on Drawings, 2" diamond mesh, 9 gauge, 80,000 psi steel wire.

B. Top and bottom selvages shall be knuckled.

C. Finish: Galvanized for all surfaces including cut ends, ASTM A 392, Class II, with not less than 2.0 oz. zinc per square foot of surface. All wire shall be smooth finished with no protruding burrs or points from galvanizing process.

2.03 STEEL FENCE FRAMING

A. Steel Pipe - Type 1: ASTM F 1083, standard weight schedule 40; minimum yield strength of 25,000 psi, sizes as required.

B. Hot-dipped galvanized, ASTM A120 or A123, with minimum average 1.8 oz/ft^2 of coated surface area.

C. Top and bottom rail: Manufacturer's longest lengths, 7" expansion sleeve with spring, for each joint. Provide means for attaching rails securely to each gate, corner, pull, and end post.

1. 1-5/8" o.d. pipe, 0.140" minimum pipe wall thickness, 2.27 lbs. per linear foot.

2.04 ACCESSORIES

A. Chain link fence accessories: ASTM F 626, provide items required to complete fence system. Galvanize each ferrous metal item and finish to match framing.

B. Post tops: Formed steel, cast malleable iron, weathertight closure cap for tubular posts. Provide one through riveted top for each post. Provide tops to permit passage of top rail.

C. Top rail and brace rail ends: Pressed steel per ASTM F 626, for connection of rail and brace to terminal posts.

D. Wire ties: 9 gauge galvanized steel wire for attachment of fabric to line posts. Double

wrap 13 gauge for rails and braces. Hog ring ties of 12-1/2 gauge for attachment of fabric to tension wire. Ties shall be spaced 1 ft. 2 in. apart on line posts and 2 ft. apart on top, bottom, and middle rails. Each end shall be wrapped around the chain link fabric at least 540 degrees.

E. Brace and tension (stretcher bar) bands: Bands shall be 11 gauge spaced not over 14" o.c, to secure stretcher bars to terminal, corner, pull, and gate posts. Install stretcher bars at vertical edges and at top and bottom edges.

F. Tension (stretcher) bars: One piece lengths equal to 2 inches less than full height of fabric with a minimum cross-section of 1/4" x ¾". Provide tension (stretcher) bars where chain link fabric meets terminal, corner, pull, and gate posts.

G. Tension wire: Galvanized coated steel wire, 7-gauge, diameter wire with tensile strength of 75,000 psi.

H. Truss rods & tightener: Steel rods with minimum diameter of 5/16". Capable of withstanding a tension of minimum 2,000 lbs.

I. Nuts and bolts shall be hot dipped galvanized.

2.05 CHAIN LINK SWING GATES

A. Gate frames: Fabricate chain link swing gates in accordance with ASTM F 900 using galvanized steel tubular members, 2" square, weighing 2.60 lb/ft. Fusion weld connections to form a rigid one-piece unit.

B. Chain link fence fabric: Install fabric with hook bolts and tension bars at all 4 sides. Attach to gate frame at not more than 15" on center.

C. Hardware materials: Hot dipped galvanized steel or malleable iron shapes to suit gate size.

D. Hinges: Structurally capable of supporting gate leaf and allow opening and closing without binding. Non-lift-off type hinge design shall permit gate to swing 180° outward.

E. Latch: Forked type capable of retaining gate in closed position and have provision for padlock. Latch shall permit operation from either side of gate.

F. Keeper: Provide keeper for each gate leaf over 5' wide. Gate keeper shall consist of mechanical device for securing free end of gate when in full open position.

G. Double gates: Provide drop rod to hold inactive leaf. Provide gate stop pipe to engage center drop rod. Provide locking device and padlock eyes as an integral part of latch, requiring one padlock for locking both gate leaves.

H. Barbed wire top: Incorporate provisions for barbed extensions by extending vertical members 13" to accommodate three strands of barbed wire.

I. Lock: Provide one padlock with (2) keys for each gate.

J. Gate posts: Steel pipe ASTM F 1083 standard weight schedule 40; minimum yield strength of 25,000 psi or steel square sections (ASTM A 500, Grade B) having minimum yield strength of 40,000 psi size as indicated. Hot-dipped galvanized with minimum 1.8 oz/ft² of zinc.

Gate leaf single width	Post Size (Round)	Weight
6 ft or less	4.00 in	9.11 lb/ft

2.06 CONCRETE MATERIAL FOR FOUNDATIONS

A. Refer to Specification Section 321313 - Site Concrete.

2.07 BARBED WIRE

A. Steel Barbed Wire: ASTM A 121, two-strand barbed wire, 0.099-inch diameter line wire with 0.080-inch diameter, four-point round barbs spaced not more than 5 inches on center.

1. Aluminum Coating: Type A.

2. Zinc Coating: Type Z, Class 3.

PART 3 - EXECUTION

3.01 PREPARATION

A. Coordinate setting posts with construction activities of other trades.

B. Verify areas to receive fencing are completed to final grades and elevations.

C. Ensure property lines and legal boundaries of work are clearly established.

D. Utility Identification: Notify PA One-Call System at 1-800-242-1776 at least 3 days prior to excavation. Coordinate with Client Agent and other contractors to determine the locations of other utility services.

3.02 CHAIN LINK FENCE FRAMING INSTALLATION

A. Install chain link fence accordance with ASTM F 567 and manufacturer's instructions.

B. Space line posts uniformly at 10' maximum on center.

C. Check each post for vertical and top alignment, and maintain in position during placement and finishing.

D. Bracing: Provide.

E. Stretcher bars: Provide one tension bar for each corner and end post. Thread tension bar through or clamp to fabric 4" o.c. and secure to posts with metal bands spaced 14" o.c.

F. Top Rail: Run rails continuously through post caps.

G. Bottom Rails: Attach to line or end posts with galvanized steel boulevard clamps.

3.03 CHAIN LINK FABRIC INSTALLATION

A. Fabric: Install fabric on security side and attach so that fabric remains in tension and fabric is flush with the bottom and top rails after pulling force is released.

B. Caps shall be provided on all post tops with rivet to post.

3.04 CHAIN LINK SWING GATE POST INSTALLATION

A. Install gate posts in accordance with the manufacturer's instructions.

3.05 GATE INSTALLATION

A. Install gates plumb, level, and secure for full opening without interference.

B. Attach hardware by means which will prevent unauthorized removal.

C. Adjust hardware for smooth operation.

3.06 CLEANING AND HANDLING

A. Clean up debris and unused material, and remove from the site.

END OF SECTION

SECTION 329113

SOIL PREPARATION

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions of the Construction Contract”, “Special Conditions”, and “Division 1 - General Requirements” form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section includes planting soils specified by composition of the mixes.

B. Related Requirements:

1. Section 329200 "Turf and Grasses" for placing planting soil for turf and grasses.

1.3 DEFINITIONS

A. AAPFCO: Association of American Plant Food Control Officials.

B. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or unamended soil as indicated.

C. CEC: Cation exchange capacity.

D. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.

E. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.

F. Imported Soil: Soil that is transported to Project site for use.

G. Layered Soil Assembly: A designed series of planting soils, layered on each other, that together produce an environment for plant growth.

H. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.

I. NAPT: North American Proficiency Testing Program. An SSSA program to assist soil-, plant-, and water-testing laboratories through interlaboratory sample exchanges and statistical evaluation of analytical data.

J. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil

organic matter."

K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

L. RCRA Metals: Hazardous metals identified by the EPA under the Resource Conservation and Recovery Act.

M. SSSA: Soil Science Society of America.

N. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

O. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

P. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.

Q. USCC: U.S. Composting Council.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include recommendations for application and use.
2. Include test data substantiating that products comply with requirements.
3. Include sieve analyses for aggregate materials.
4. Material Certificates: For each type of imported soil and soil amendment and fertilizer before delivery to the site, according to the following:

    a. Manufacturer's qualified testing agency's certified analysis of standard products.
    b. Analysis of fertilizers, by a qualified testing agency, made according to AAPFCO methods for testing and labeling and according to AAPFCO's SUIP #25.
    c. Analysis of nonstandard materials, by a qualified testing agency, made according to SSSA methods, where applicable.

1.5 INFORMATIONAL SUBMITTALS

A. Soils Testing results for imported topsoil and samples obtained from the site with recommendations from the testing agency for soil treatments and soil amendments to be incorporated to produce satisfactory planting soil suitable for healthy, viable turf lawn indicated.

B. Field quality-control reports.

1.6 QUALITY CONTROL

A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.

1.7 REGULATORY COMPLIANCE

A. Compliance with the following laws and regulations: Pennsylvania Agricultural Liming Materials Act of 1978, P.L. 15, No.9, as amended, Agricultural Liming Materials Rules & Regulations (7 Pa. Code, Part V. Chapter 108), Pennsylvania Soil Conditioner and Plant Growth Substance Law, Act of December 1, 1977, Pl. 258, No. 86 (3P.S.68.2) as amended.

PART 2 - PRODUCTS

2.1 PLANTING SOILS SPECIFIED BY COMPOSITION

A. General: Soil amendments, fertilizers, and rates of application specified in this article are guidelines that may need revision based on testing laboratory's recommendations after preconstruction soil analyses are performed.

2.2 FERTILIZERS

A. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

C. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

PART 3 - EXECUTION

3.1 GENERAL

A. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.

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

3.2 PLACING AND MIXING PLANTING SOIL OVER EXPOSED SUBGRADE

A. General: Apply and mix unamended soil with amendments on-site to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Mixing: Spread unamended soil to total depth of 6 inches, but not less than required to meet finish grades after mixing with amendments and natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.

1. Amendments: Apply soil amendments and fertilizer, if required, evenly on surface, and thoroughly blend them with unamended soil to produce planting soil.

C. Compaction: Compact each blended lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D 698 and tested in-place.

D. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.3 CLEANING

A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.

B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Department's property unless otherwise indicated.

END OF SECTION 329113

SECTION 329200

TURF AND GRASSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The specifications sections “General Conditions of the Construction Contract”, “Special Conditions”, and “Division 1 - General Requirements” form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Seeding.
2. Hydroseeding.

1.3 INFORMATIONAL SUBMITTALS

A. Certification of Grass Seed
   1. Certification of each seed mixture for turfgrass sod. Include identification of source and name and telephone number of supplier.
B. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.4 QUALITY CONTROL

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment.

1.5 REGULATORY COMPLIANCE

A. Comply with specifications of NPDES permit as primary, then follow 'B.' for other areas.

B. Compliance with the following laws and regulations: Pennsylvania Seed Act of 1965 (Act No. 187), Regulations of the Pennsylvania Department of Agriculture, Bureau of Plant Industry, Pennsylvania Soil Conditioner and Plant Growth Substance Law, Act of December 1, 1977, P.L. 258, No. 86 (3P.S.68.2) as amended.

PART 2 - PRODUCTS

2.01 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Rules for Testing Seeds" for purity and germination tolerances.

B. Seed Species:

1. Quality: State-certified seed of grass species as listed below for solar exposure.
2. Temporary Seeding:

a. 100% Annual Rye Grass

3. Sun and Partial Shade: Proportioned by weight as follows:

a. 70 percent perennial ryegrass (Lolium perenne).
b. 30 percent red fescue (Festuca rubra variety).

4. Shade: Proportioned by weight as follows:

a. 35 percent chewings red fescue (Festuca rubra variety).
b. 35 percent hard fescue (Festuca longifolia or duriuscula).
c. 30 percent creeping red fescue ((Festuca rubra subp. rubra).

PART 3 - EXECUTION

3.01 EXAMINATION

A. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by the Professional and replace with new planting soil.

3.02 TURF AREA PREPARATION

A. Before planting, obtain the Professionals acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.03 SEEDING

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph.

2. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
3. Do not use wet seed or seed that is moldy or otherwise damaged.

B. Sow seed at a total rate of:

1. Temporary Seeding: 10 lb/1000 sq. ft.
2. Sun and Partial Shade: 2.5 lb/1000 sq. ft.
3. Shade: 5 lb/1000 sq. ft

C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.

D. Protect seeded areas from hot, dry weather or drying winds by applying mushroom manure within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly at a rate of 2-4 cubic yards per 1000 sq. ft. and rake lightly.

3.04 TURF RENOVATION

A. Renovate turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.

3.05 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by the Professional:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.

3.10 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off the Department's property.

C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

D. Remove nondegradable erosion-control measures after grass establishment period.

END OF SECTION 329200

SECTION 330500

COMMON WORK RESULTS FOR UTILITIES

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions of the Construction Contract”, “Special Conditions”, and “Division 1 - General Requirements” form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. This Section includes the following:

1. Piping joining materials.
2. Dielectric fittings.
3. Sleeves.
4. Identification devices.
5. Grout.
6. Piping system common requirements.
7. Equipment installation common requirements.
8. Concrete bases.
9. Metal supports and anchorages.

1.3 DEFINITIONS

A. Exposed Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.

B. Concealed Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Dielectric fittings.
2. Identification devices.

B. Welding certificates.

1.5 QUALITY CONTROL

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

B. Steel Piping Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

PART 2 - PRODUCTS

2.1 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness, unless otherwise indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Solvent Cements for Joining Plastic Piping:

1. ABS Piping: ASTM D 2235.
2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

H. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.2 DIELECTRIC FITTINGS

A. Dielectric Fittings, General: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Unions:
   1. Description: Factory fabricated, union, NPS 2 and smaller.
      a. Pressure Rating: 150 psig minimum at 180 deg F.
      b. End Connections: Solder-joint copper alloy and threaded ferrous; threaded ferrous.

C. Dielectric Flanges:
   1. Description: Factory-fabricated, bolted, companion-flange assembly, NPS 2-1/2 to NPS 4 and larger.
      a. Pressure Rating: 150 psig minimum.
      b. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric Couplings:
   1. Description: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining, NPS 3 and smaller.
      a. Pressure Rating: 300 psig at 225 deg F.
      b. End Connections: Threaded.

E. Dielectric Nipples:
   1. Description: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining.
      a. Pressure Rating: 300 psig at 225 deg F.
      b. End Connections: Threaded or grooved.

2.3 SLEEVES

A. Mechanical sleeve seals for pipe penetrations are specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

B. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

C. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized, plain ends.

D. Cast-Iron Sleeves: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

E. Molded PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe Sleeves: ASTM D 1785, Schedule 40.

G. Molded PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.4 IDENTIFICATION DEVICES

A. Equipment Nameplates: Metal permanently fastened to equipment with data engraved or stamped.

1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and essential data.
2. Location: Accessible and visible.

B. Snap-on Plastic Pipe Markers: Manufacturer's standard preprinted, semirigid, snap-on type. Include color-coding according to ASME A13.1, unless otherwise indicated.

C. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers, extending 360 degrees around pipe at each location.

D. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers, at least three times letter height and of length required for label.

E. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.

1. Arrows: Either integrally with piping system service lettering to accommodate both directions of flow, or as separate unit on each pipe marker to indicate direction of flow.

F. Plastic Tape: Manufacturer's standard color-coded, pressure-sensitive, self-adhesive vinyl tape, at least 3 mils thick.

1. Width: 1-1/2 inches on pipes with OD, including insulation, less than 6 inches; 2-1/2 inches for larger pipes.
2. Color: Comply with ASME A13.1, unless otherwise indicated.

G. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch sequenced numbers. Include 5/32-inch hole for fastener.
1. Material: Valve manufacturer's standard solid plastic.
2. Size: 1-1/2 inches in diameter, unless otherwise indicated.
3. Shape: As indicated for each piping system.

H. Valve Tag Fasteners: Brass, wire-link or beaded chain; or brass S-hooks.

I. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.

1. Engraving: Engraver's standard letter style, of sizes and with terms to match equipment identification.
2. Thickness: 1/16 inch, for units up to 20 sq. in. or 8 inches in length, and 1/8 inch for larger units.
3. Fasteners: Self-tapping, stainless-steel screws or contact-type permanent adhesive.

J. Plastic Equipment Markers: Manufacturer's standard laminated plastic, in the following color codes:

1. Green: Cooling equipment and components.
2. Yellow: Heating equipment and components.

3. Brown: Energy reclamation equipment and components.
4. Blue: Equipment and components that do not meet criteria above.
5. Hazardous Equipment: Use colors and designs recommended by ASME A13.1.
6. Terminology: Match schedules as closely as possible. Include the following:

    a. Name and plan number.
    b. Equipment service.
    c. Design capacity.
    d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.

7. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.

2.5 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 DIELECTRIC FITTING APPLICATIONS

A. Dry Piping Systems: Connect piping of dissimilar metals with the following:

1. NPS 2 and Smaller: Dielectric unions.
2. NPS 2-1/2 and Larger: Dielectric flanges.

B. Wet Piping Systems: Connect piping of dissimilar metals with the following:

1. NPS 2 and Smaller: Dielectric couplings or dielectric nipples.
2. NPS 2-1/2 and Larger: Dielectric nipples.

3.2 PIPING INSTALLATION

A. Install piping according to the following requirements and utilities Sections specifying piping systems.

B. 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 the Coordination Drawings.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping to permit valve servicing.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Select system components with pressure rating equal to or greater than system operating pressure.

I. Sleeves are not required for core-drilled holes.

J. Permanent sleeves are not required for holes formed by removable PE sleeves.

K. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of equipment areas or other wet areas 2 inches Insert dimension above finished floor level.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.

a. PVC Pipe Sleeves: For pipes smaller than NPS 6.
b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.

L. Verify final equipment locations for roughing-in.

M. Refer to equipment specifications in other Sections for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and utilities Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

G. Grooved Joints: Assemble joints with grooved-end pipe coupling with coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

H. Soldered Joints: Apply ASTM B 813 water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B 32.

I. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

J. Pressure-Sealed Joints: Assemble joints for plain-end copper tube and mechanical pressure seal fitting with proprietary crimping tool to according to fitting manufacturer's written instructions.

K. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 appendixes.
3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
5. PVC Nonpressure Piping: Join according to ASTM D 2855.
6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

L. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

M. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

N. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End PE Pipe and Fittings: Use butt fusion.
2. Plain-End PE Pipe and Socket Fittings: Use socket fusion.

O. Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.

2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Install dielectric fittings at connections of dissimilar metal pipes.

3.5 EQUIPMENT INSTALLATION

A. Install equipment level and plumb, unless otherwise indicated.

B. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference with other installations. Extend grease fittings to an accessible location.

C. Install equipment to allow right of way to piping systems installed at required slope.

3.6 IDENTIFICATION

A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.

1. Plastic markers, with application systems. Install on insulation segment if required for hot noninsulated piping.
2. Locate pipe markers on exposed piping according to the following:

    a. Near each valve and control device.
    b. Near each branch, excluding short takeoffs for equipment and terminal units. Mark each pipe at branch if flow pattern is not obvious.
    c. Near locations where pipes pass through walls or floors or enter inaccessible enclosures.
    d. At manholes and similar access points that permit view of concealed piping.
    e. Near major equipment items and other points of origination and termination.

B. Equipment: Install engraved plastic-laminate sign or equipment marker on or near each major item of equipment.

1. Lettering Size: Minimum 1/4 inch high for name of unit if viewing distance is less than 24 inches, 1/2 inch high for distances up to 72 inches, and proportionately larger lettering for greater distances. Provide secondary lettering two-thirds to three-fourths of size of principal lettering.
2. Text of Signs: Provide name of identified unit. Include text to distinguish among multiple units, inform user of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

C. Adjusting: Relocate identifying devices that become visually blocked by work of this or other Divisions.

3.7 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3500-psi, 28-day compressive-strength concrete and reinforcement as specified in Section 033000 "Cast-in-Place Concrete."

3.8 GROUTING

A. Mix and install grout for equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 330500

SECTION 33 16 00

VERTICAL POLYETHYLENE STORAGE TANKS

PART 1-GENERAL

1.1. STIPULATIONS

The specifications sections " General Conditions to the Construction Contract ", "Special Conditions", and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 REFERENCES, CODES AND STANDARDS

A. American Society of Testing Materials (ASTM).

1. D638	Tensile Properties of Plastics
2. D883	Standard Definitions of Terms Relating to Plastics
4. D1505	Density of Plastics by the Density-Gradient Technique
5. D1693	ESCR Specification Thickness 0.125" F50-10% Igepal
6. F412	Standard Terminology Relating to Plastic Piping Systems

B. ANSI Standards: B-16.5, Pipe Flanges and Flanged Fittings

C. Building Code: International Building Code, IBC 2015

D. ARM: Low Temperature Impact Resistance (Falling Dart Test Procedure).

E. NSF/ANSI Standard 61, AWWA – Drinking Water System Components

F. ASTM D-1998, Standard Specification for Polyethylene Upright Storage Tanks

1.3 SUBMITTALS

A. Shop Drawings: Submit the following as a single complete initial submittal. Sufficient data shall be included to show that the product conforms to Specification requirements. Provide the following additional information:

1. Vertical tank and Fitting Material

a. Resin Manufacturer Data Sheet

b. Fitting Material

c. Gasket style and material

d. Bolt material

2. Dimensioned Tank Drawings

   a. Location and orientation of openings, fittings, accessories, restraints and supports.

   b. Details of manways, flexible connections, and vents.

3. Delegated Design: Drawings, specifications and calculations shall be stamped and signed by a qualified mechanical engineer licensed to practice in the Commonwealth of Pennsylvania.

   a. Tank restraint system. Show seismic and wind criteria.

   b. Tank fittings, all piping connections, fittings, valves, and flow calculations.

   c. Sequence of operation narrative.

B. Manufacturer’s warranty

C. Manufacturer's unloading procedure

D. Manufacturer's installation instructions

E. Supporting information of Quality Management System.

F. Electrical heat tracing and foam insulation data sheets as required.

G. Factory Test Report

1. Wall thickness verification.

2. Fitting placement verification.

3. Visual inspection

4. Impact test

5. Gel test

6. Hydrostatic test

1.4 QUALITY CONTROL

A. Tanks shall be manufactured from virgin materials.

B. Tanks shall be manufactured from materials certified to NSF/ANSI Standard 61 for chemical storage and submit form from NSF supporting chemical certification.

C. Manufacturer’s Qualifications: Submit to engineer a list of 5 installations in the same service as proof of manufacturer's qualifications.

1.5 WARRANTY

A. The warranty shall be a limited 5 year full replacement warranty.

PART 2 – PRODUCTS

2.1 GENERAL

A. Tanks shall be rotationally-molded, vertical, high density cross-linked polyethylene, one-piece seamless construction, cylindrical in cross-section and vertical with flat bottoms. Tanks shall be adequately vented as prescribed Venting-Design for ACFM (air cubic feet per minute). Where indicated, tanks shall be provided with ancillary mechanical fittings and accessories. Tanks shall be marked to identify the manufacturer, date of manufacture and serial numbers must be permanently embossed into the tank.

2.2 MANUFACTURER

A. Basis of Design manufacturer: Poly Processing Company.
B. Other acceptable manufacturers include EnduraPlas, Norwesco or other manufacturer as approved by Architect.

2.3 POLYETHYLENE STORAGE TANKS

A. Service: Storage tanks shall be suited for the following operating conditions:

B. Basis of Design product shall be Model #1010300 as manufactured by Poly Processing Company or equal and shall contain ultraviolet stabilizer as recommended by resin manufacturer. The tank material shall be rotationally molded and be a resin that is commercially available at the time of tank manufacture.

D. Wall thickness for a given hoop stress is to be calculated in accordance with ASTM D 1998. **In no case shall the tank thickness be less than design requirements per ASTM D 1998**.

1. The wall thickness of any cylindrical portion at any fluid level shall be determined by the following equation:

$T = P \times OD/2SD$ or $0.433 \times SG \times H \times OD/2SD$

Where:

T	=	wall thickness, in
P	=	pressure, psi
SG	=	specific gravity, gm/cc
H	=	fluid head, ft
OD	=	outside diameter, ft
SD	=	hydrostatic design stress

a. The minimum wall thickness shall be sufficient to support its own weight in an upright position without external support but shall not be less than 0.187” thick.

2. On closed top tanks the top head shall be integrally molded with the cylindrical wall. Its minimum thickness shall be equal to the thickness of the top of the straight sidewall. In most cases, flat areas shall be provided for attachment of large fittings on the dome of the tank.

3. The bottom head shall be integrally molded with the cylindrical wall. Knuckle radius shall be:

Tank Diameter, ft	Min Knuckle Radius, in
less than or equal to 6	1
greater than 6	1-1/2

4. Tanks with 3000 gal capacity or larger shall have at least 3 lifting lugs. Lugs shall be designed for lifting the tank when empty.

b. Unless otherwise indicated by Contract drawings, for outdoor pneumatic fill, manways shall be 24-in diameter or greater and equipped with Poly Processing Company's F.S.2650 combined manway and vent to prevent over pressurization of tank. Manway must be capable of relieving a volume flow rate of up to 2650 ACFM. Gaskets shall be closed cell, cross-linked polyethylene foam, Viton, or EPDM materials.

c. Unless otherwise indicated, tanks less than 2000 gallons in non-pneumatic applications shall have a manway cover 17-in or smaller of Polyethylene material with a coarse thread. Gaskets shall be closed cell, cross-linked polyethylene foam, viton or EPDM materials.

NOTE: Tanks must be vented to allow for performance at atmospheric pressure, in accordance with the following matrix:

Venting Requirements For Polyethylene Tanks

Mechanical Pump Fill	**Pneumatic Fill**								
IF ≤ 1000 gallons	**IF** - Vent length ≤ 3 feet			**IF** - Vent length > 3' and ≤ 30'			**IF** - Scrubber Application		
Vent size should equal size of largest fill or discharge fitting	**AND - Vent** screen mesh size ≥ 1/4" or no screen used			**AND -** 3 or less 90° elbows with no other restrictions or reduction in pipe size			**Vent pipe size throughout scrubber system CANNOT be reduced!**		
							Centerline of dispersion pipe not to be submersed > 6 inches		
IF > 1000 gallons	**Emergency Pressure Relief Cover Required**			**Emergency Pressure Relief Cover Required**			Perforated dispersion pipe must be same diameter or larger, as vent. Sum of perforations ≥ cross sectional area of pipe		
Vent size should exceed the largest fill or discharge fitting by 1 inch	Tanker Discharge	Inlet/Fitting Size	Minimum Vent Size	Tanker Discharge	Inlet/Fitting Size	Minimum Vent Size	Tanker Discharge	Inlet/Fitting Size	Minimum Vent Size
	2"	2"	4"	2"	2"	6"	2"	2"	6"
	3"	2"	6"	3"	2"	6"	3"	2"	8"
	3"	3"	6"	3"	3"	8"	3"	3"	10"

(2) 2 inch vents **DO NOT EQUAL** 4 inch venting capacity rev. Nov 2006
For detailed venting guidelines, please visit our Technical Resources at www.polyprocessing.com

E. Tank colors shall be natural (unpigmented).

2.4 TANKS:

A. Tank Schedule per the following specifications

B. Fittings

1. Tank fittings shall be according to the fitting schedule in 2.05B above. Threaded fittings shall use American Standard Pipe Threads. If tanks are insulated, fittings shall be installed at the factory prior to application of the insulation.

2. Bolted flange fittings shall be constructed of one 150 lb. flange with ANSI bolt pattern, one flange gasket and stud bolts with gaskets. Stud bolts to have chemical resistant

polyethylene injection molded heads and gaskets to provide a sealing surface between the bolt head and the interior tank wall. Stud bolt heads are to be color coded for visual ease of identifying the bolt material by onsite operators. Green- 316 Stainless Steel, Black- Titanium, Red- Alloy C-276, Blue- Monel. All materials shall be compatible with chemical service and as indicated in the fitting schedule above. For NSF/ANSI 61 certification, EPDM or Viton GF gaskets shall be supplied.

3. Down Pipes and Fill Pipes: Down pipes and fill pipes shall be supported at 6-ft max intervals. Down pipes and fill pipes shall be PVC or material compatible with the chemical stored.

5. U-Vents: Each tank must be vented for the material and flow and withdrawal rates expected. Vents should comply with OSHA 1910.106(F)(iii)(2)(IV)(9). U-vents shall sized by the tank manufacturer and be furnished complete with insect screen if required (Insect screen lessens the vent capacity by 1/3) in accordance with the venting schedule listed above.

6. All fittings on the 1/3 lower sidewall of tanks with capacities $\geq$ 1000 gallons shall have 100% virgin PTFE Flexijoint expansion joint. Expansion joint to have a minimum of 3 convolutions, stainless steel limit cables and FRP composite flanges. Galvanized parts will not be accepted.

   Expansion joint to meet the following minimum performance requirements:

   Axial Compression $\geq$ 0.67”
   Axial Extension $\geq$ 0.67”
   Lateral Deflection $\geq$ 0.51”
   Angular Deflection $\geq$ 14º
   Torsional Rotation $\geq$ 4º

2.5 LEVEL INDICATION

A. Float Indication: The level indicator shall be assembled to the tank and shall consist of PVC float, indicator, polypropylene rope, perforated interior pipe, PVC roller guides, clear UV resistant PVC sight tube EnviroKing by C.F. Harvel, and necessary pipe supports. The level indicator shall act inversely to the tank contents and shall not allow entrance of tank contents into the sight tube at any time. Indicator shall be neon orange color for visual ease for onsite operators.

B. Ultrasonic Level Indicator: The ultrasonic level indicator shall be a Flowline ultrasonic level

2.6 FACTORY TESTING

A. Material Testing

1. Perform gel and low temperature impact tests in accordance with ASTM D 1998 on condition samples cut from each polyethylene chemical storage tank.

2. Degree of Crosslinking. Use Method C of ASTM D 1998- Section11.4 to determine the ortho-xylene insoluble fraction of cross-linked polyethylene gel test. Samples shall test at no less than 60 percent.

B. Tank Testing

1. Dimensions: Take exterior dimensions with the tank empty, in the vertical position. Outside diameter tolerance, including out-of-roundness, shall be per ASTM D 1998. Fitting placement tolerance shall be +/- 1/2-in vertical and +/- 1 degree radial.

2. Visual: Inspect for foreign inclusions, air bubbles, pimples, crazing, cracking, and delamination.

3. Hydrostatic test: Following fabrication, the bottom tanks, including inlet and outlet fittings, shall be hydraulically tested with water by filling to the top sidewall for a minimum of 1 hour and inspected for leaks. Following successful testing, the tank shall be emptied and cleaned prior to shipment.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

A. The tank shall be shipped upright or lying down on their sides with blocks and slings to keep them from moving. Avoid sharp objects on trailers.

B. All fittings shall be installed and, if necessary, removed for shipping and shipped separately unless otherwise noted by the contractor.

C. Upon arrival at the destination, inspect the tank(s) and accessories for damage in transit. If damage has occurred, Poly Processing Company shall be notified immediately.

3.2 INSTALLATION

A. Install the tanks in strict accordance with Tank Installation Manual and shop drawings.

B. Installation will be inspected by manufacturer to verify system flexible connections, venting and fittings are properly installed. In addition to on-sight inspection tank system(s) to be reviewed using tank manual check list as supplied by manufacture as listed below.

C. Manufacturer to provide 1 hour training session to prepare operators to service and maintain the tank system. Included in training session will be (#) training manuals.

D. Manufacturer's trained technician to do an onsite inspection of installation. Inspection will verify chemical application, plumbing connections, venting, and applicable ancillary equipment such as ladders, restraints, etc. A verification of proper installation certificate will be supplied when equipment passes installation checklist.

E. Tank manuals will consist of installation check lists, tank drawing(s) as built, fitting drawings referencing nozzle schedule on tank drawing, materials of construction, and recommended maintenance program.

3.3 FIELD TESTING

A. Tanks shall be hydro-tested for 24 hours prior to commissioning.

END OF SECTION 33 16 00

SECTION 334200

STORMWATER CONVEYANCE

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions of the Construction Contract”, “Special Conditions”, and “Division 1 - General Requirements” form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

A. Section Includes:

Pipe and fittings.

Nonpressure transition couplings.

Expansion joints and deflection fittings.

Drains.

Encasement for piping.

Catch basins.

Stormwater inlets.

Stormwater disposal systems.

1.4 ACTION SUBMITTALS

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

B. Shop Drawings:

Stormwater inlets. Include plans, elevations, sections, details, frames, covers, and grates.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle stormwater inlets according to manufacturer's written rigging instructions.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Client Agency or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

Notify Client Agency no fewer than 15 days in advance of proposed interruption of service.

Do not proceed with interruption of service without Client Agency's written permission.

PART 2 - PRODUCTS

2.1 PE PIPE AND FITTINGS

A. Corrugated PE Drainage Pipe and Fittings NPS 3 to NPS 10: AASHTO M 252M, Type S, with smooth waterway for coupling joints.

Silttight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with tube and fittings.

Soiltight Couplings: AASHTO M 252M, corrugated, matching tube and fittings.

B. Corrugated PE Pipe and Fittings NPS 12 to NPS 60: AASHTO M 294M, Type S, with smooth waterway for coupling joints.

Silttight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with pipe and fittings.

Soiltight Couplings: AASHTO M 294M, corrugated, matching pipe and fittings.

2.2 NONPRESSURE TRANSITION COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:

For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.

For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings:

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:

Basis-of-Design Product: Subject to compliance with requirements, provide the following:

a. Fernco Inc.

b. Mission Rubber Company

c. Horsecraft USA

d. Or equal as approved by the professional.

Description: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Ring-Type, Flexible Couplings:

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:

Basis-of-Design Product: Subject to compliance with requirements, provide the following:

a. ADS (Advanced Drainage Systems)

b. Fernco Inc.

c. Mission Rubber Company

d. Horsecraft USA

e. Or equal as approved by the professional.

Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

2.3 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, ACI 350/350R, and the following:

Cement: ASTM C 150, Type II.

Fine Aggregate: ASTM C 33, sand.

Coarse Aggregate: ASTM C 33, crushed gravel.

Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.

Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.

Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.

Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.

Benches: Concrete, sloped to drain into channel.

D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.

Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.

Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

2.4 STORMWATER INLETS

A. Yard Inlets: Include heavy duty frames and gates.

B. Frames and Grates: Heavy duty, according to utility standards.

2.5 GROUT

A. Description: ASTM C1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

Characteristics: Post hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.

Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. Install gravity-flow, nonpressure drainage piping according to the following:

Install piping pitched down in direction of flow.

Install piping NPS 6 and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.

Install piping with 12 inch minimum cover.

Install nonreinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure drainage piping according to the following:

Join corrugated PE piping according to ASTM D 3212 for push-on joints.

ASTM F 794 for gasketed joints.

Join fiberglass sewer piping according to ASTM D 3839 for elastomeric-seal joints.

Join nonreinforced-concrete sewer piping according to ASTM C 14 and ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.

Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.

Join dissimilar pipe materials with nonpressure-type flexible couplings.

3.4 MANHOLE INSTALLATION

A. General: Install inlets, complete with appurtenances and accessories indicated.

B. Install precast concrete inlet sections with sealants according to ASTM C 891.

C. Where specific inlet construction is not indicated, follow inlet manufacturer's written instructions.

D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops flush with finished surface elsewhere unless otherwise indicated.

3.5 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

3.6 CONNECTIONS

A. Make connections to existing piping and underground manholes.

Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

B. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.

Use pressure-type pipe couplings for force-main joints.

3.7 IDENTIFICATION

A. Materials and their installation are specified in Section 312000 "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.

Use detectable warning tape over ferrous piping.

Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.8 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

Submit separate reports for each system inspection.

Defects requiring correction include the following:

Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.

Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

Do not enclose, cover, or put into service before inspection and approval.

Test completed piping systems according to requirements of authorities having jurisdiction.

Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.

Submit separate report for each test.

Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:

3.9 CLEANING

A. Clean interior of piping of dirt and superfluous materials. Flush with water.

END OF SECTION 334200

SECTION 48 14 00
SOLAR PHOTOVOLTAIC (PV) SYSTEM

PART 1 – GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions to the Construction Contract ", "special conditions", and "division 01 - general requirements" form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

B. This section specifies the furnishing, installation, connection, testing and commissioning of a solar photovoltaic (PV) system.

1.3 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.

B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Requirements for low-voltage conductors.

C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and requirements for providing a low impedance path for possible ground fault currents.

D. Section 26 05 33, RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS: Requirements for boxes, conduits, and raceways.

1.4 DEFINITIONS

A. Unless otherwise specified or indicated, electrical and electronics terminology used in these specifications, and on the drawings, shall be as defined in IEEE 100 CD.

B. Unless otherwise specified or indicated, solar energy conversion and solar photovoltaic energy system terminology used in these specifications, and on the drawings, shall be as defined in ASTM E772.

1.5 QUALITY CONTROL

A. Solar Energy Electrical Power Generation System installer(s) shall demonstrate that they have successfully installed at least four projects within the past five years that, in aggregate, equal or exceed the size of the proposed project. References shall be provided for each of the referenced qualified projects.

B. Supports and racking for solar photovoltaic system designs shall be prepared under the seal of a licensed Professional Structural Engineer (PE). Where applicable, such as roof top installations, the engineer shall also provide adequate review and structural analysis of the existing structure that will be supporting the proposed solar photovoltaic system. Among the documents that shall be submitted by the engineer are environmental loading analyses (including wind, snow, hail, and where applicable, seismic) and the rack and substrate's ability to withstand these environmental forces. In the instance where the rack is installed on the ground, adequate information shall be presented to demonstrate the earth's ability to support the proposed design.

C. If paralleling arrangement is desired, the system shall have anti-islanding capability such that it is incapable of exporting power to the utility distribution system in the absence of utility power. Paralleling must be approved by serving electric utility. Provide written correspondence from the utility confirming its requirements.

D. Investigate any other local ordinances that may apply to installation of a solar energy electrical generating system in the proposed location. Bring any conflicts with the drawings and specifications to the attention of the Resident Engineer.

E. Warranties: The solar energy electrical generating system warranty period shall be as noted for the items below:

1. Solar photovoltaic modules and inverter: 10-year manufacturer's warranty against defects in materials and workmanship.

2. Power output: 25-year manufacturer's power output warranty, with the first 10 years at 90% minimum rated power output and the balance of the 25 years at 80% minimum rated power output.

1.6 SUBMITTALS

A. Where proposed system shall be a Net Meter project, prepare appropriate applications and submittals to the Resident Engineer. Where proposed system shall be connected before the serving electric utility's meter and tied directly to the grid, prepare appropriate applications and submittals to the Resident Engineer. In all cases, the serving electric utility may have a requirement for further electrical studies, which may include or not be limited to power factor analysis, short circuit protection studies, grid wiring adequacy, or capacities of upstream equipment. If such requirements exist and are required by the serving electric utility, these requirements shall be fulfilled by the Contractor. Provide written documentation confirming the utility's approval of the interconnection of the solar energy electrical power generation system with the utility system.

B. The Contractor is responsible for completing the application for the solar PV array for First Energy.

C. Submittals shall comply with paragraph, SUBMITTALS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. Shop Drawings:

a. Submit sufficient information to demonstrate compliance with drawings and specifications.

b. Include electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, wiring and connection diagrams, accessories, and nameplate data.

c. Include shop drawings for foundations and other support structures.

2. Product Data:

a. Include detailed information for components of the solar energy electrical generation system.
   1. Wiring.
   2. Inverter.
   3. Photovoltaic modules.
   4. Rack and support assemblies.
   5. Instrumentation.
   6. Switchgear.
   7. DC and AC disconnects.
   8. Combiner boxes.
   9. Monitoring systems.

3. Manuals:

a. Submit, simultaneously with the shop drawings, complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering replacement parts.
   1. Safety precautions.
   2. Operator restart.
   3. Startup, shutdown, and post-shutdown procedures.
   4. Normal operations.
   5. Emergency operations.
   6. Environmental conditions.
   7. Preventive maintenance plan and schedule.
   8. Troubleshooting guides and diagnostic techniques.
   9. Wiring and control diagrams.
   10. Maintenance and repair procedures.
   11. Removal and replacement instructions.
   12. Tracking systems (where applicable).
   13. Spare parts and supply list.
   14. Parts identification.
   15. Testing equipment and special tool information.
   16. Warranty information.
   17. Testing and performance data.
   18. Contractor information.

b. If changes have been made to the maintenance and operating manuals originally submitted, then submit updated maintenance and operating manuals two weeks prior to the final inspection.

4. Certifications: Two weeks prior to final inspection, submit the following.

a. Certification by the manufacturers of all major items of the solar energy electric generation system that the system conforms to the requirements of the drawings and

specifications, and that they have jointly coordinated and properly integrated their equipment and controls to provide a complete and functional installation.

b. Certification by the Contractor that the solar energy electric generation system has been properly installed, adjusted, tested, commissioned, and warrantied. Contractor shall make all necessary field measurements and investigations to ensure that the equipment and assemblies meet contract requirements.

5. Estimated Annual Power Output: Submit calculated annual power output for each of the proposed solar photovoltaic systems. Provide independent calculations for each fixed system.

D. If equipment submitted differs in arrangement from that shown on the drawings, provide drawings that show the rearrangement of all associated systems. Approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract and acceptable to the Resident Engineer.

E. Submittals and shop drawings for independent but related items shall be furnished together and complete in a group. Coordinate and properly integrate materials and equipment in each group. Final review and approval will be made only by groups.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide materials to fabricate functioning photovoltaic system in accordance with ASTM, IEEE, NEMA, NFPA, and UL, as specified in this section, and as shown on the drawings.

B. Factory-prefabricated solar equipment packages which include photovoltaic modules, batteries or other energy storage, inverters, and controls and which meet the requirements of this section are acceptable.

2.2 GROUNDING

A. All applicable components of the solar energy electrical power generating system must be grounded per latest NEC requirements.

B. DC Ground-Fault Protector:

1. Shall be listed per UL 1703.

2. Shall comply with requirements of the NEC.

2.3 PHOTOVOLTAIC ARRAY CIRCUIT COMBINER BOX

A. Shall be listed to UL 1741.

B. Shall include internal overcurrent protection devices with dead front.

C. Shall be contained in non-conductive NEMA Type 4X enclosure.

D. Up to 48 volts DC: Shall use UL-listed DC breakers that meet NEC requirements for overcurrent protection.

E. Up to 600 volts DC, paralleling system: Shall use fuses instead of breakers.

F. Ground and pole-mounted arrays shall have a separate combiner box mounted to the pole itself.

G. Where applicable, combiner box shall be a disconnecting combiner box.

2.4 SWITCH/DISCONNECTING MEANS

A. Shall be UL-listed, in accordance with the NEC, as shown on the drawings, and as specified.

B. Utility External Disconnect Switch (UEDS): Coordinate requirements with serving electric utility.

2.5 WIRING SPECIALTIES

A. Direct Current Conductors:

1. If Exposed: Shall be USE-2, UF (inadequate at 60°C [140°F]), or SE, 90°C [194°F] wet-location rated and sunlight-resistant (usually for tracking modules).

2. If in Conduit: Shall be RHW-2, THWN-2, or XHHW-2 90°C [194°F], wet-location rated.

B. Conduits and Raceways:

1. Shall use steel conduit listed per UL 6, UL 1242, UL 797 (as appropriate), except for tracking modules. Weathertight EMT installations shall be allowed for DC wiring in weather-protected areas.

2. Shall use expansion joints on long conduit runs.

3. Shall not be installed on photovoltaic modules.

C. Enclosures subject to weather shall be rated NEMA 3R or better.

D. Cable Assemblies and Junction Boxes:

1. Shall be UL-listed.

2. Shall be rated to 5VA flammability per UL 94.

E. Prohibited Wiring Materials: Those which are not UL-listed, or listed materials used in environments outside those covered in their listing.

2.6 DC-AC INVERTER

A. Shall be listed to UL 1741.`

B. Shall comply with IEEE 519 and IEEE 1547.

C. Shall be listed per FCC Part 15 Class A.1.

D. Shall have stand-alone, utility-interactive, or combined capabilities.

E. Shall include anti-islanding protection if paralleling arrangement is required.

2.7 SOLAR PHOTOVOLTAIC (PV) MODULES

A. Minimum Performance Parameters as per IBC 1509.7.4, IRC M2302.3, UL 1703.

B. Photovoltaic Panel Types:

1. Monocrystalline: Listed to UL 1703.

2. Polycrystalline: Listed to UL 1703.

C. Module and System Identification

1. Module or Panel:

a. Listed to UL 969 for weather resistance.

b. Listed to UL 1703 for marking contents and format.

2. Main Service Disconnect: per NEC.

3. Identification Content and Format: per NEC.

4. Identification for DC Conduit, Raceways, Enclosures, Cable Assemblies, and Junction Boxes: IFC 605.

5. Identification for Inverter: per NEC.

D. Bypass diodes shall be built into each PV module either between each cell or each string of cells.

E. Other Components: per UL 1703.

F. Hail Protection: Compliant with testing procedure per ASTM E-1038.

G. Lightning Protection: Shall ground according to manufacturer instructions per UL 1703.

H. Access, Pathways, and Smoke Ventilation: Per IFC 605.3, access and spacing requirements must be observed in order to: ensure access to the roof, provide pathways to specific areas of the roof, provide for smoke ventilation opportunities area, and, where applicable, provide emergency access egress from the roof.

I. Fire Classification:

1. IBC 1505.8 for building-integrated photovoltaic and solar shingles.

2. IBC 1509.7.2: Although not technically enforceable, every effort shall be made to ensure the solar photovoltaic module is not combustible.

2.8 COLLECTOR SUPPORTS

A. Wind Resistance Requirement:

1. For rack-mounted: per IBC 1509.7.1.

2. For building-integrated photovoltaic and solar shingles: IBC 1507.17.3.

B. Mechanical Load Requirement: per UL 1703.

C. Ground and Pole Mount:

1. Foundations shall be designed by a licensed Professional Structural Engineer (PE).

2. Where possible, combiner boxes shall be mounted directly to the pole itself.

2.9 INSTRUMENTATION

A. Meters: If applicable and system is grid-connected, use net smart meter provided by the serving electric utility.

B. Sensors:

1. Temperature sensor shall be a component in the MPPT control system.
2. May install additional data acquisition sensors to measure irradiance, wind speed, and ambient and PV module temperatures. Any additional sensors shall require a conduit separate from the current conductor conduit.

C. Data logger/Monitoring System: Shall be a packaged system capable of string-level monitoring or in the case of micro-inverters, capable of monitoring and logging an individual module's information.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install the solar photovoltaic system in accordance with the NEC, this section, and the printed instructions of the manufacturer.

B. Prior to system start-up, ensure no copper wire remains exposed with the exception of grounding wire as allowed in certain circumstances per manufacturer's instructions.

C. Wiring Installation: Workers shall be made aware that photovoltaic modules will be live and generating electricity when there is any ambient light source and shall take appropriate precautions. Utilize on-site measurements in conjunction with engineering designs to accurately cut wires and layout before making permanent connections. Locate wires out of the way of windows, doors, openings, and other hazards. Ensure wires are free of snags and sharp edges that have the potential to compromise the wire insulation. All cablings shall be mechanically fastened. If the system is roof-mounted, it shall have direct current ground fault protection according to NEC. Ensure breakers in combiner box are in the off position (or fuses removed) during combiner box wiring.

D. Instrumentation: Install instruments as recommended by the manufacturer. Locate control panels inside a room accessible only to qualified persons.

E. Rack-Mounted Photovoltaic Installations: Rack-mounted photovoltaic modules shall be installed in accordance with the manufacturer's installation instructions.

F. Ground and Pole-Mounted Photovoltaic Installations: If structure is used as equipment grounding conductor, ensure compliance with NEC. Wiring shall not be readily accessible.

G. Provide safety signage per NEC.

3.2 FIELD QUALITY CONTROL

A. Field Inspection: Perform in accordance with manufacturer's recommendations. Prior to initial operation, inspect the solar energy electrical power generation system for conformance to drawings, specifications, and NEC. In addition, include the following:

1. Visual Inspection and Tests:
    a. Compare equipment nameplate data with specifications and approved shop drawings.
    b. Inspect physical, electrical, and mechanical condition.
    c. Verify required area clearances.

d. Verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method or performing thermographic survey after energization.

e. Verify the correct operation of all sensing devices, alarms, and indicating devices.

f. Verify that all cable entries from top of junction boxes are sealed per junction box rating.

g. Verify all connections and integrity of printed circuit boards in all applicable junction boxes.

B. Tests: Provide equipment and apparatus required for performing tests. Correct defects disclosed by the tests and repeat tests. Conduct tests in the presence of the Resident Engineer.

1. Module String Voltage Test: Prior to connecting wiring to the combiner box, use a digital multi-meter to ensure each series string's polarity is correct.

2. Operational Tests: Perform tests in accordance with the manufacturer's written recommendations. Tests for stand-alone systems shall be performed per IEEE 1526.

3.3 FOLLOW-UP VERIFICATION

A. Upon completion of acceptance checks, settings, and tests, the Contractor shall show by demonstration in service that the solar photovoltaic electrical power generation system is in good operating condition and properly performing the intended function.

3.4 COMMISSIONING

A. If the system is grid-tied, the Contractor shall coordinate with the serving electric utility to establish an interconnection agreement.

B. Connect the solar photovoltaic electrical power generation system to the serving electric utility grid only after receiving prior approval from the utility company.

C. Only qualified personnel shall connect the solar photovoltaic electrical power generation system to the serving electric utility grid.

3.5 INSTRUCTION

A. A complete set of operating instructions for the solar photovoltaic electrical power generation system shall be laminated or mounted under acrylic glass and installed in a frame near the equipment.

B. Furnish the services of a factory-trained technician for one, 4-hour training period for instructing personnel in the maintenance and operation of the solar photovoltaic electrical power generation system, on the date requested by the Resident Engineer.

END OF SECTION 48 14 00