



**100% SPECIFICATIONS
ISSUED FOR BID**

24 July 2014

**SECURITY FORCES ADMIN &
STORAGE FACILITY**

MISSOURI AIR NATIONAL GUARD

PROJECT NO. ULYB112022

SUBMITTED TO

**139TH AIRLIFT WING
MISSOURI AIR NATIONAL GUARD
705 MEMORIAL DRIVE
ST. JOSEPH, MISSOURI 64503-9307**

SUBMITTED BY



ARCHITECT'S PROFESSIONAL SEAL

The drawings, specifications, and other documents referenced in the enclosed Table of Contents for this project (identified in the header above) have been prepared by or under the direct supervision of the following licensed architect(s), with the exception of the following: portions of Divisions 3, 5, and 31-33 specifications, the entire Divisions 21-28 specifications, and the drawings identified as "Civil", "Structural", "Mechanical", "Electrical" "Fire Protection", and "Telecom". Those documents pertain directly to the work of the consultants involved with this project, who will separately identify and seal the work for which they are responsible.

The Bidding and Contractual documents have been prepared solely by the Owner.



CIVIL ENGINEER'S PROFESSIONAL SEAL



STRUCTURAL ENGINEER'S PROFESSIONAL SEAL

The following structural sheets were produced by the company of KDK Engineering LLC

S001 – General Notes

S101 – Framing Plans & Steel Details

S201 – Concrete Schedules & Details

Specifications were edited for job specifics.

Darren Reynolds, P.E. S.E.



MECHANICAL/ELECTRICAL ENGINEER'S PROFESSIONAL SEAL



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SECTION 010000 - GENERAL CONDITIONS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Except as otherwise expressly provided herein, the Contractor shall furnish all plant, labor, materials, tools, appliances, equipment, services, fuel and transportation required to complete the construction of the:

SECURITY FORCES ADMIN & STORAGE FACILITY
ULYB 112022

MISSOURI AIR NATIONAL GUARD, ROSECRANS MEMORIAL AIRPORT ST. JOSEPH, MISSOURI

1.2 DESCRIPTION OF PROJECT

- A. The work included in this Contract is comprised of GENERAL CONSTRUCTION of Security Forces Admin & Storage Facility project and associated sitework.
- B. Any reference included on drawings or within these specifications to "Contracting Officer" shall read "The Contracting Officer or his/her duly Authorized Representative".

1.3 DIVISION OF WORK

- A. The various divisions of the Specifications and drawings shall not be considered as segregation of the material and labor involved. The arrangement and order of these divisions have been made for Government convenience only, and it is not the intent, nor shall it be so construed that work included in any one division must be performed by a particular trade or subcontractor.
- B. No claims for extra arising out of real or alleged error in such arrangement or order of the various divisions will be given consideration.
- C. Reference Contract Clause 52.236-21, entitled "Specifications and Drawings for Construction."

1.4 CONTRACTOR SUBMITTAL

- A. General: The Contractor shall submit for approval all shop drawings, samples, certificates of compliance, equipment lists and other items as called for under the various headings of these specifications. These drawings, samples, certificates and lists shall be complete and detailed per Contract Clause 52.236-21 entitled "Specifications & Drawings for Construction."
1. Whenever a brand name is used in the specification it is used for information purposes to describe a standard of quality only, unless specifically indicated otherwise.
 2. Wherever specifications require that items bear the label of the Underwriters Laboratories, Inc., or similar organization, the contractor may utilize the following procedures:
 - a. The Contractor shall submit proof that the item which he proposes to use under this specification conforms to the standard of the applicable testing organization. The label

- of applicable testing organization shall be accepted as conforming to these requirements.
- b. In lieu of the label, the Contractor may submit a written certification from any nationally recognized testing agency, adequately equipped and competent to perform such services, that the item has been tested and conforms to the standards including methods of test, of the testing organization.

B. Unless otherwise specified in the Technical Specification the minimum number of copies to be submitted shall be three (3) for each item. The Contractor shall complete AF Form 3000 with each shop drawing, sample, certificate of compliance, or equipment list submitted. Blank forms will be furnished by the Contracting Officer on request. Shop drawings for submittal shall be either blue line or black line prints on a white background. In lieu of blue or black line prints, single copies of vellums or mylars may be acceptable, confer with the Contracting Officer for acceptance. Each shop drawing, certificate of compliance, and/or equipment list shall be identified with the following information as applicable:

Project Number Specification/Drawing Reference One (1) set of each submittal shall be retained by the Contracting Officer.

C. Coordination and Sequencing: Coordinate the preparation and processing of submittal with the performance of the work but submit not later than required by Appendix 1 entitled "Schedule of Submittal". No extension of time will be allowed because of failure to properly coordinate and sequence submittals. Allow a minimum of 21 days (excluding mailing time) for approval of routine submittals. Allow 45 days (excluding mailing time) for larger or more complex submittals (examples include structural steel or combined electrical and mechanical submittals, etc.).

D. Samples: Refer to individual sections of these specifications for type and number requested. Submit four (4) of each sample if not otherwise noted. Maintain one (1) set of approved samples at the project site, available for quality control comparison. Up to two (2) sets of samples may be retained by the government.

1.5 SPARE PARTS LIST AND MAINTENANCE AND OPERATIONS (OSM) MANUALS

A. Provide as identified within individual specification sections.

1.6 ENVIRONMENTAL PROTECTION

A. General: Environmental pollution is defined as the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare: unfavorably alter ecological balances of importance to human life; affect other species of importance to man; or degrade the utility of the environment for aesthetic purposes. The control of environmental pollution requires consideration of air, water, and land, and involves noise, solid waste management and management of radiant energy and radioactive materials, as well as other pollutants.

B. Applicable Regulations: The Contractor and his subcontractors shall comply with all applicable laws and regulations concerning environmental pollution control and abatement, San Joaquin Air Pollution Control District rules and requirements and all applicable provisions of the Corps of Engineers Manual, EM 385-1-1, entitled Safety and Health Requirements Manual, as well as the specific requirements stated elsewhere in the contract specifications.

C. Protection of Land Resources: It is intended that the land resources within the project boundaries and outside the limits of permanent work performed under this contract be preserved in their present condition or be restored to a condition after completion of construction that will appear to be natural and not detract from the appearance of the project. In so far as possible, the contractor shall confine

his construction activities to areas defined by the plans or specifications. Contractor's attention is directed to the requirements of Contract Clauses entitled:

"Clean Air and Water" "Hazardous Material Identification and Material Safety Data" "Protection of Existing Vegetation, Structures, Equipment, Utilities and Improvements" "Operations and Storage Areas" "Cleaning Up"

D. Dust and Foreign Object Damage (FOD) Control: The Contractor shall prevent the generation of dust and FOD due to his operation in construction zones, along haul routes, in equipment parking areas, and in waste areas. This action may consist of water sprinkling or an equivalent service for dust control and pavement sweeping for FOD control. Failure to provide adequate dust and FOD control measures may result in temporary stop work notices until the situation is corrected.

E. Implementation: Prior to commencement of the work, the Contractor shall:

1. Submit a plan for implementing this section for environmental pollution control.
2. Meet with representatives of the Contracting Officer to develop mutual understandings relative to compliance with this provision and administration of the environmental protection program.

F. The Contractor shall complete the Contractor Hazardous Materials Identification form. This form and Executive Order dated September 14, 1998 are included at the end of this section

1. The Contractor shall report the usage of all hazardous materials used in the construction of or incorporated into the project via the Contractor Hazardous Materials Identification Form (Attachment 1). This form will be initiated prior to bringing any hazardous materials on site.
2. The Contractor shall properly store and dispose of hazardous materials in accordance with OSHA standards, MSDS requirements, or other regulations (using the most stringent) and shall control access and use of such materials. The Contractor will certify on the Contractor Hazardous Material Identification form the quantities used and disposed of and that disposal was properly accomplished.

G. Use of Recovered/Recycled Materials: Compliance with the executive order mandating the use of recovered/recycled materials is required for all DOD contractors, as appropriate.

1.7 CONSTRUCTION QUALITY CONTROL

A. General: The Contractor shall manage his operations in such a manner as to control the quality of all work being performed to meet his obligations under the terms of this contract per Contract Clause 52.246-12 entitled "Inspection of Construction." He shall submit his plan for the system he proposes to use to effect this control within fifteen days after the notice to proceed is received. The plan shall include the personnel, facilities, methods and procedures he proposes to use, and inspections and tests and any actions resulting from them shall be included. A review of the Contractor's plan will be made at a joint meeting with the Contracting Officer. When the plan is both plausible and in conformance with contract requirements, a tentative approval will be issued in writing by the Contracting Officer, subject to satisfactory application and results during the construction. Any changes to the approved plan, personnel or procedures, desired by the Contractor, require the prior approval of the Contracting Officer. Change requests and approvals must be in writing. No construction is to be started until the plan has been tentatively approved unless specific written authority is granted by the Contracting Officer. If the Contractor's system fails to produce acceptable results, the Contracting Officer may direct such changes or take such other actions, at the Contractor's expense, as are necessary to assure contract compliance.

B. Contractor's Quality Control Plan: The plan shall include as a minimum the following.

1. The Contractor's organizational structure indicating the manner in which quality control is

- integrated into the job-site management.
2. The names, positions, and qualifications of all quality control personnel or organizations and their specific responsibilities. The QC organization may be supplemented as necessary by additional personnel, special technicians and/or testing agencies.
 3. The authority vested in each individual or agency, including testing laboratories hired for the purpose shall be established in writing to the individual or agency signed by the Contractor and a copy shall be included in the Contractor's plan.
 4. The manner, methods, procedures and techniques to be employed in the execution of the daily inspections and tests.
 5. A sample of the format which the Contractor proposes to use for his daily Quality Control report. Legible copies of the daily inspection reports shall be maintained by the Contractor at the project site at all times and copies shall be submitted to the COR weekly. The daily inspections shall include the type of work being performed during the report period and such other items as required to assure adequate quality control. Results of all tests and validations performed by the contractor in accordance with the contract shall be attached to the daily construction quality control report.
 6. The location and description of all testing facilities and equipment to be used on-site.
 7. Procedures for control, submittal and checking of contractor submittal required under the General Conditions paragraph entitled "Contractor Submittal." Procedures for checking materials and equipment received at the job-site for compliance with approved submittal.
 8. Procedures for checking material and equipment received at the job-site for compliance with approved submittal.

C. Inspection Procedures: The inspection procedure which the Contractor uses shall be based on the following guidelines:

1. Preparatory Inspection: This should be performed prior to beginning any work on any definable feature. It should include a review of contract requirements; a check to assure that all materials and or equipment have been tested, submitted, and approved; a check to assure that provisions have been made to provide required control testing; examination of the work area to ascertain that all preliminary work has been completed; and a physical examination of materials and equipment to assure that they conform to approved shop drawings or submittal data and that all necessary materials and/or equipment are on hand.
2. Initial Inspection: This should be performed as soon as work begins on a representative portion of the particular feature of work and should include examination of the quality of workmanship as well as a review of control testing for compliance with control requirements.
3. Follow-up Inspections: These should be performed daily to assure continuing compliance with contract requirements, including control testing, until completion of the particular feature of work. The Contracting Officer may require joint Government-Contractor inspections at any time and on a periodic basis to evaluate the Quality Control System's effectiveness. Such inspections shall be reported on the Contractor's Daily Quality Control Report. Plan for Inspections, Tests and Instructions: Within 30 days after NTP, the Contractor shall submit for approval his proposed plan and schedule for the inspections, tests and instructions called for under the various headings of these specifications. The plan shall include the name and qualifications of the engineer who will conduct the tests and/or provide the instructions, together with a narrative of the proposed tests, log data sheets to record data, a list of instruments and recording devices to be used including serial numbers and date last calibrated, and the proposed calculations to prove the functional and operating efficiency and/or capacity specified. All operating and maintenance instruction, and wiring, control, and flow diagrams as called for in the specifications shall be on hand or posted, as specified, prior to starting the tests and/or instructions.

D. Plan for Inspections, Tests and Instructions: Within 30 days after NTP, the Contractor shall

submit for approval his proposed plan and schedule for the inspections, tests and instructions called for under the various headings of these specifications. The plan shall include the name and qualifications of the engineer who will conduct the tests and/or provide the instructions, together with a narrative of the proposed tests, log data sheets to record data, a list of instruments and recording devices to be used including serial numbers and date last calibrated, and the proposed calculations to prove the functional and operating efficiency and/or capacity specified. All operating and maintenance instruction, and wiring, control, and flow diagrams as called for in the specifications shall be on hand or posted, as specified, prior to starting the tests and/or instructions.

1.08 CONTRACTOR QUALITY CONTROL TESTS

- A. General: Neither specified minimum numbers of tests nor the lack of them shall in any way limit or relieve the Contractor of his responsibility to perform adequate tests to assure compliance with the quality requirements of these specifications.
- B. Tests shall be made in accordance with the specified testing procedures and/or methods and otherwise as required to provide compliance with all contract requirements. Tests shall be made in independent, state registered commercial testing laboratories approved in writing by the Contracting Officer.
- C. Results of all tests shall be recorded on certified reports, signed and sealed by a professional registered engineer. Reports shall include a statement that the materials tested do or do not meet the requirements of the contract specifications. Four (4) copies of all reports shall be forwarded directly to the Contracting Officer from the testing laboratory.
- D. Any item, for which test reports show failure to meet all contract requirements shall be retested as often as required to show full compliance with contract requirements, at the Contractor's expense. If the Contracting Officer so requires, items which fail on testing to meet requirements shall then be tested in place thereof, at the Contractor's expense.

1.09 GOVERNMENT INSPECTION

- A. The Contractor shall notify the Contracting Officer's Representative (816) 236-3040.
 - 1. At least 72 hours before the work is to start.
 - 2. When a work stoppage of more than 48 hours duration is anticipated.
 - 3. At least 24 hours in advance of returning to work after a work stoppage.
 - 4. At least 5 working days in advance of desired time for final inspection.
 - 5. At least 24 hours in advance of performing tests and check-outs, unless more stringent notification times are called for in the specifications.
 - 6. At least 24 hours in advance of permanently closing or covering up areas of work that will no longer be available for inspection (walls, ceilings, excavations, etc.).
- B. Failure to make the arrangements specified above may result in non-acceptance of work.

1.10 PERMITS

- A. The Contractor shall obtain an approved Work Clearance Request, AF Form 103, from the Base Civil Engineer prior to commencement of ANY work. A separate Form 103 is required for each discrete area to be disturbed.
 - 1. One an area to be excavated has been marked, the contractor is solely responsible for maintaining all markings throughout the life of the contract as needed to facilitate his work. Requests for remarking will result in a charge to the contractor of \$200 for each request.

- B. The Contractor shall obtain an approved Welding, Cutting and Brazing Permit, AF Form 592, from the ANG Base Fire Department prior to welding or starting any open flames. This permit must be renewed daily.
- C. The Contractor shall provide a list of contract personnel names, social security numbers and contractor or sub-contractor name to the Contracting Officer's Representative for access to the Base. Names shall be submitted on an electronic submission form that will be provided at the Pre-construction conference. Access rosters shall be submitted electronically to the COR not later than COB Thursday for access the following week. Personnel not on an access list will not be allowed entry to the base (vendors excluded).
- D. Other Federal, State and local permits may be required as referenced in Contract Clause 52.236-7 entitled "Permits and Responsibilities."

1.11 NORMAL WORKING HOURS:

- A. Normal working hours are 0700-1700 Tuesday-Friday, Federal Holidays (and in lieu of holidays) accepted. Contractor may not access the facility earlier than 0645 nor depart later than 1715.
- B. If the Contractor, for his convenience desires to perform during other than normal working hours or on other than normal working days, and such requests are approved by the contracting officer, he shall reimburse the Government for any additional expense occasioned the Government thereby, such as, but not limited to, overtime pay for Government Inspectors, utilities services, etc. These requests will only be approved for exceptional circumstances and are subject to the availability of government personnel.

1.12 AS-BUILT DRAWINGS

- A. The Contractor shall maintain a set of contract drawings on the work site and daily update said drawings for As-Built conditions of all trades. Include all conditions of final installation both visible and hidden. These drawings shall be submitted to the Contracting Officer upon completion of the job and are subject to inspection by the government at any time during the job. Shop drawings will not replace red-lined as-builts, although they may supplement. Reference Contract Clause 52.236-21 "Specifications and Drawings for Construction."

1.13 SCRAP MATERIAL

- A. Materials specified to be removed or demolished are the property of the Contractor (unless otherwise noted).

1.14 PLANNED UTILITY OUTAGES

- A. All utility outages shall be of as short a duration as possible and shall be scheduled as far in advance as possible with the Contracting Officer, in no case less than fourteen (14) days before the outage. The Contractor shall obtain in writing from the Contracting Officer a statement or schedule giving the permissible times of outages for particular installations and the maximum time allowed for each outage. The Contractor shall strictly observe such schedules and will be held responsible for any violations.

1.15 SITE SECURITY/ACCESS/EGRESS

- A. Install substantial and durable temporary enclosure of partially completed areas of construction, with locking entrances, adequate to prevent unauthorized entrance, vandalism, theft, and similar deleterious effects and violations of project security.
- B. Where materials and equipment must be temporarily stored, prior to and during construction, and are of substantial value or attractive for possible theft, provide secure lock-up and enforce strict discipline in connection with the timing of installation and release of materials, so that the opportunity for theft and vandalism is minimized.

1.16 MATERIAL DELIVERIES

- A. Materials shipped by a transportation agency shall NOT be shipped to the Air National Guard. The Contractor shall ensure that his or his subcontractor's material orders are shipped to either his or his subcontractor's address and subsequently delivered to the job site. Packages and/or deliveries addressed to a contractor in care of or to the Air National Guard address will be rejected/returned. The ANG will not be responsible for delays caused by rejection/return of materials erroneously shipped to the base.
- B. Materials delivered directly by the vendor shall be delivered to the job site or construction lay-down area. It is the Contractor's responsibility to ensure that the vendor knows where the materials are to be delivered or to provide escort as required. The ANG will not sign for or accept materials/equipment if no Contractor personnel are available to sign when items are delivered. Although vendor delivery drivers are not required to be on an access list the Contractor should coordinate expected deliveries with the Main Gate to expedite delivery.

1.17 WRITTEN WARRANTIES

- A. All work including workmanship, material and equipment (other than Government furnished equipment) shall be guaranteed in writing for the full period of standard manufacturer's warranty, but in no case shall be guaranteed for a period of less than one (1) year from the date of final acceptance. Upon receipt of notice from the Government of any failure during this guarantee period, the part or parts shall be replaced promptly with new parts by and at the expense of the Contractor. Whenever the Manufacturer of a piece of equipment supplied by the Contractor customarily provides a guarantee or warranty covering the equipment the Contractor shall promptly turn over such to the Contracting Officer. Reference Contract Clause 52.246-21 entitled "Warranty of Construction."

1.18 CLOSEOUT

- A. Prior to final acceptance of the completed work complete the following:
 - 1. Submit special guarantees, warranties, workmanship bonds, maintenance agreements, and similar documents.
 - 2. Submit record drawings, damage or settlement survey, and similar final record information.
 - 3. Deliver tools, spare parts, extra stock of materials, and similar physical items.
 - 4. Discontinue and remove from the project site temporary facilities and services, along with construction tools, and facilities, mock-ups, and similar elements.
 - 5. Submit completed DD Form 1354 Checklist (to be provided at Pre-Construction Conference).

1.19 TEMPORARY UTILITY SERVICES

- A. General: The Government will allow free access to natural gas (for building HVAC only), water and electricity required for the performance of the work per Contract Clause 52.236-14 "Availability & Use of Utility Services." Point of connection to existing utilities shall be approved in advance by the Contracting Officer.
- B. Contractor shall coordinate telephone service with AT&T. Coordinate service installation plan with the Contracting Officer prior to actual installation.

1.20 EXAMINATION OF SITE

- A. The Contractor shall carefully examine the site of the work, the Drawings, and the Specifications. The execution of the Contract shall be conclusive evidence that the Contractor has investigated and is satisfied as to the conditions to be encountered; as to the character, quality, and quantities of the work to be performed and the materials to be furnished; and as to requirements of Drawings, Specifications and the Contract.

PART 2 -PRODUCTS - Not Used.

PART 3 -EXECUTION - Not Used.

END OF SECTION 010000

SECTION 01 1000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes:
 - 1. Project information.
 - 2. Work covered by Contract Documents.
 - 3. Work by Owner.
 - 4. Specification and drawing conventions.

1.3 PROJECT INFORMATION

- A. Project Identification: Security Forces Admin and Storage Facility, Missouri Air National Guard
 - 1. Project Location: Missouri Air National Guard, 705 Memorial Drive, St. Joseph, MO 64503
- B. Owner: Missouri Air National Guard, 139th Airlift Wing, 705 Memorial Drive, St. Joseph, MO 64503.
- C. Owner's Representative: Base Civil Engineer
- D. Architect of Record: Charles R. Smith, HTK Architects, 900 S Kansas Avenue, Suite 200, Topeka, Kansas 66612.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. Type of Contract
 - 1. Project will be constructed under a single prime contract.
- B. The Work consists of the following:
 - 1. The Work consists of construction of a new 6000 SF Security Forces Facility for the Missouri Air National Guard on the site, including site development, and other site utility improvements.
 - 2. The Work includes construction of a pre-engineered metal building system.
 - 3. Interior finishing and related construction including interior partitions, doors, floor and ceiling finishes, plumbing, mechanical, electrical, fire sprinkler, telecommunication and audio / visual systems.

1.5 WORK BY OWNER

- A. General: Cooperate fully with Owner so work may be carried out smoothly, without interfering with or delaying work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.
- B. Subsequent Work: Owner may perform additional work at site after and/or during this project. Completion of that work will depend on successful completion of preparatory work under this Contract.

1.6 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet (8 m) of entrances, operable windows, or outdoor-air intakes.

1.7 PERIOD OF PERFORMANCE

- A. Contractor shall have 360 calendar days to complete the work detailed in the drawings and specifications.

1.8 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 - 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on the Drawings are described in detail in the Specifications. One or more of the following are used on the Drawings to identify materials and products:
 - 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 - 2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings.
 - 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

END OF SECTION 01 1000

SECTION 01 2300 – OPTIONAL BID ITEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. This sections refers to Optional Bid Items. The terminology “Options”, “Alternate Bids” and “Alternate / Additive Bid Items (ABIs)”, are the same.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for optional bid items.

1.3 DEFINITIONS

- A. Optional Bid Item: An amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
 - 1. Optional Bid Items described in this Section are part of the Work only if enumerated in the Agreement.
 - 2. The cost or credit for each Optional Bid Item is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

- A. Coordination: Modify or adjust affected adjacent work as necessary to completely integrate work of the option into Project.
 - 1. Include as part of each Option, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of Optional Bid Item.
- B. Options may be selected by the owner in any order and any number of options deemed necessary.
- C. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each Option. Indicate if Options have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to Options.
- D. Execute accepted Options under the same conditions as other work of the Contract.

- E. Schedule: A schedule of Optional Bid Items is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each Option.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES / ADDITIVE BID ITEMS

- A. Provide on the bid form line, the add/deduct for products listed as Optional Bid Items. List manufacturer provided where requested on the bid form.
- B. Schedule of Optional Bid Items:
1. All casework and finish plumbing for break room 114. Plumbing rough-in to the locations shown shall be part of the base bid.
 2. Painting of the steel structure and exposed conduit and ductwork in Mobility Storage room 101. The back side of the metal panels do not require painting.
 3. Parking lot surface type shown to be 6" Aggregate Surfacing shall be replaced with 8" Asphaltic Concrete Surfacing. Final surface elevations shall prevail. Additional costs for excavation or fill modification to accommodate the difference in surface depths shall be included in the Bid Item.
 4. Three windows in training rooms 116A/B.
 5. Operable partition wall in training rooms 116A/B. Support structure for wall shall be part of the base bid. Building structure shall be designed to support weight of wall as part of base bid.
 6. Wall tile in restrooms and locker rooms. Base bid shall be epoxy paint on walls in restrooms and locker rooms. Wall tile in shower area shall be part of the base bid.
 7. Eastern extension of Comm Duct Bank from MH-C22 and Comm vault MH-C23.

END OF SECTION 01 2300

SECTION 01 2500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.

1.3 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 - 1. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Substitution Request Form: Use CSI Form 13.1A.
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
 - b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable specification section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.

- i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
 - j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
 - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

- A. Coordination: Modify or adjust affected work as necessary to integrate work of the approved substitutions.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

- A. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Architect.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities

Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.

- b. Requested substitution does not require extensive revisions to the Contract Documents.
- c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
- d. Substitution request is fully documented and properly submitted.
- e. Requested substitution will not adversely affect Contractor's construction schedule.
- f. Requested substitution has received necessary approvals of authorities having jurisdiction.
- g. Requested substitution is compatible with other portions of the Work.
- h. Requested substitution has been coordinated with other portions of the Work.
- i. Requested substitution provides specified warranty.
- j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 2500

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Requirements:
 - 1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

1.3 MINOR CHANGES IN THE WORK

- A. Architect will issue through General Contractor supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time specified in Proposal Request after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - e. Quotation Form: Use forms acceptable to Architect.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect .

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use form acceptable to Architect.

1.5 ADMINISTRATIVE CHANGE ORDERS

- A. Allowance Adjustment: See Section 012100 "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.
- B. Unit-Price Adjustment: See Section 012200 "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

1.6 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Changes Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701 form included in Project Manual.

1.7 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Work Change Directive: Architect may issue a Construction Work Change Directive on AIA Document G714 form. Construction Work Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 1. Construction Work Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Work Change Directive.
 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
 - 1. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 2. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.
 - 3. Section 018113.13 "Sustainable Design Requirements - LEED for New Construction and Major Renovations" for administrative requirements governing submittal of cost breakdown information required for LEED documentation.

1.3 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with continuation sheets.
 - b. Submittal schedule.
 - c. Items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Architect through General Contractor at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
 - 3. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.
 - 4. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.

5. Subschedules for Separate Design Contracts: Where the Owner has retained design professionals under separate contracts who will each provide certification of payment requests, provide subschedules showing values coordinated with the scope of each design services contract as described in Section 011000 "Summary."

B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
2. Arrange schedule of values consistent with format of AIA Document G703 EJCDC Document C-620 Insert name and designation of standard form.
3. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.
4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
 - a. Include separate line items under Contractor and principal subcontracts for LEED documentation and other Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
6. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.
7. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
8. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.

9. Purchase Contracts: Provide a separate line item in the schedule of values for each purchase contract. Show line-item value of purchase contract. Indicate owner payments or deposits, if any, and balance to be paid by Contractor.
10. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.
11. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and Construction Manager and paid for by Owner.
 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Construction Manager will return incomplete applications without action.
 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
 1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.

- b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- F. Transmittal: Submit electronic signed and notarized copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- H. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 5. Waiver Forms: Submit executed waivers of lien on forms, acceptable to Owner.
- I. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of values.
 3. LEED submittal for project materials cost data.
 4. Contractor's construction schedule (preliminary if not final).
 5. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
 6. Products list (preliminary if not final).
 7. LEED action plans.
 8. Schedule of unit prices.
 9. Submittal schedule (preliminary if not final).
 10. List of Contractor's staff assignments.
 11. List of Contractor's principal consultants.
 12. Copies of building permits.
 13. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 14. Initial progress report.
 15. Report of preconstruction conference.
 16. Certificates of insurance and insurance policies.
 17. Performance and payment bonds.

18. Data needed to acquire Owner's insurance.
- J. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- K. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
 5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
 6. AIA Document G707, "Consent of Surety to Final Payment."
 7. Evidence that claims have been settled.
 8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 9. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 01 3100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. Administrative and supervisory personnel.
 - 2. Requests for Information (RFIs).
 - 3. Project meetings.
- B. Related Sections:
 - 1. Division 01 Section "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
 - 2. Division 01 Section "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 3. Division 01 Section "Closeout Procedures" for coordinating closeout of the Contract

1.3 DEFINITIONS

- A. RFI: Request to Owner, Architect, or Contractor seeking information from each other during construction.

1.4 KEY PERSONNEL

- A. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and email addresses. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.
 - 1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.5 REQUESTS FOR INFORMATION (RFIs)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
 - 1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
 - 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.
 2. Project number.
 3. Date.
 4. Name of Contractor.
 5. Name of Architect.
 6. RFI number, numbered sequentially.
 7. RFI subject.
 8. Specification Section number and title and related paragraphs, as appropriate.
 9. Drawing number and detail references, as appropriate.
 10. Field dimensions and conditions, as appropriate.
 11. Contractor's suggested resolution. If Contractor's solution(s) impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 12. Contractor's signature.
 13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
1. The following RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for coordination information already indicated in the Contract Documents.
 - d. Requests for adjustments in the Contract Time or the Contract Sum.
 - e. Requests for interpretation of Architect's actions on submittals.
 - f. Incomplete RFIs or inaccurately prepared RFIs.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 01 Section "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
- E. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.
- F. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log monthly at progress meetings. Use CSI Log Form 13.2B or software generated log. Include the following:
1. Project name.

2. Name and address of Contractor.
3. Name and address of Architect.
4. RFI number including RFIs that were dropped and not submitted.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's response was received.
8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

1.6 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.

- B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.

1. Conduct the conference to review responsibilities and personnel assignments.
2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Tentative construction schedule.
 - b. Phasing.
 - c. Critical work sequencing and long-lead items.
 - d. Designation of key personnel and their duties.
 - e. Lines of communications.
 - f. Procedures for processing field decisions and Change Orders.
 - g. Procedures for RFIs.
 - h. Procedures for testing and inspecting.
 - i. Procedures for processing Applications for Payment.
 - j. Distribution of the Contract Documents.
 - k. Submittal procedures.
 - l. Preparation of record documents.
 - m. Use of the premises and existing building.
 - n. Work restrictions.
 - o. Working hours.
 - p. Owner's occupancy requirements.
 - q. Responsibility for temporary facilities and controls.
 - r. Procedures for disruptions and shutdowns.
 - s. Construction waste management and recycling.
 - t. Parking availability.

- u. Office, work, and storage areas.
 - v. Equipment deliveries and priorities.
 - w. First aid.
 - x. Security.
 - y. Progress cleaning.
4. Minutes: The Architect is responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction or as requested by Architect.
- 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
 - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Options.
 - b. Related RFIs.
 - c. Related Change Orders.
 - d. Review of mockups.
 - e. Possible conflicts.
 - f. Compatibility problems.
 - g. Time schedules.
 - h. Space and access limitations.
 - i. Installation procedures.
 - j. Required performance results.
 - k. Protection of adjacent work.
 - 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 - 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 - 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Progress Meetings: Conduct progress meetings at bi-weekly intervals.
- 1. Coordinate dates of meetings with preparation of payment requests.
 - 2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how

construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

- 1) Review schedule for next period.
- b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site utilization.
 - 8) Temporary facilities and controls.
 - 9) Progress cleaning.
 - 10) Quality and work standards.
 - 11) Status of correction of deficient items.
 - 12) Field observations.
 - 13) Status of RFIs.
 - 14) Status of proposal requests.
 - 15) Pending changes.
 - 16) Status of Change Orders.
 - 17) Pending claims and disputes.
 - 18) Documentation of information for payment requests.
4. Minutes: The Architect is responsible for conducting the meeting and will record meeting minutes; incorporating detailed submittal, RFI, change order, etc. status reports prepared by the Contractor. The Architect will distribute the meeting minutes to each party present and to parties requiring information.
 - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 3100

SECTION 01 3300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Related Sections:
 - 1. Division 01 Section "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Contracting Officer responsive action. Action submittals are those submittals indicated in individual Specification Sections as action submittals.
- B. Informational Submittals: Written and graphic information and physical samples that do not require Contracting Officer responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as informational submittals.
- C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.
- D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.4 ACTION SUBMITTALS

- A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time requested for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time requested for making corrections or modifications to submittals noted by the Contracting Officer and requested additional time for handling and reviewing submittals required by those corrections.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect's/Engineer's Digital Data Files: Electronic copies of CAD Drawings of the Contract Drawings will be made available by Architect for Contractor's use in preparing submittals, when requested by the Contractor.
1. Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings and Project record drawings.
 - a. Neither Architect, Engineer nor the Owner makes any representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
 - b. Digital Drawing Software Program: The Contract Drawings are available in AutoCAD 2008.
 - c. The Contractor will receive the digital documents in their "as-is" or "native" condition in which the Design Professional uses and organizes the data, which may, in most conditions, not directly correspond to the printed sheet format.
 - d. The Contractor shall execute a digital data licensing agreement establishing the conditions for data file use and releasing the Owner and Architect/Engineers of any liability or subrogation claims due to the accuracy or completeness of the electronic data files provided. The form of agreement shall be in the form of AIA Document C106, Digital Data Licensing Agreement, as included at the end of this section. Upon execution of a contract and when requested by the Contract, a final licensing agreement will be drafted for execution.
 - e. The Contractor shall pay a fee of \$100 per printed document page for digital data file(s) to the Architect to cover the Architect/Engineer's costs for packaging and delivering. The contractor will be required to pay the fee for all printed drawing sheets in the contract documents where needed or requested, or not due to the multi-sheet multi-discipline integration of digital data files.
 - f. Allow 14 days upon receipt of written request of documents for packaging and delivery.
 - g. The Architect will release digital data drawing files to the General Contractor, only. Distribution and costs of distribution to subcontractors and suppliers from the General Contractor will be determined by the General Contractor.
 - h. The following Digital Data files will be furnished for each appropriate discipline, when requested:
 - 1) Complete Contract Document Set
 - 2) Complete sets of individual discipline(s)
 - 3) Portions of sets of each discipline
 - i. The following pdf files will be furnished for each appropriate discipline, when requested:
 - 1) Complete Contract Document Set
 - 2) Complete sets of each discipline
 - 3) Portions of sets of each discipline
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.

3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect/Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
 - b. Architect/Engineer reserves the right to withhold action on a submittal submitted out of sequence with the submittal schedule or the construction schedule critical path.
 - c. Architect/Engineer reserves the right to withhold action on a submittal requiring color selection coordination with other submittals other color sensitive submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Contracting Officer's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Reference Article 6 of Document D for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Contracting Officer will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow 15 days for review of each resubmittal.
 4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, the review period will be extended.
 - a. All submittals will require sequential review by the Architect and Contracting Officer.
- D. Identification and Information: Place a permanent label or title block on each paper copy submittal item for identification.
1. Indicate name of firm or entity that prepared each submittal on label or title block.
 2. Include the following information for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Name of subcontractor.
 - f. Name of supplier.
 - g. Name of manufacturer.
 - h. Submittal number or other unique identifier, including revision identifier.
 - 1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).
 - i. Number and title of appropriate Specification Section.
 - j. Drawing number and detail references, as appropriate.

- k. Location(s) where product is to be installed, as appropriate.
 - l. Other necessary identification.
- E. Identification and Information: Identify and incorporate information in each electronic submittal file as follows:
 - 1. Assemble complete submittal package into a single indexed file with links enabling navigation to each item.
 - 2. Name file with submittal number or other unique identifier, including revision identifier.
 - a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., SOR-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., SOR-061000.01.A).
 - 3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
 - 4. Provide AF FORM 3000 (current version) as cover letter for Government Approval for each submittal.
 - 5. Include the following information on a sub cover sheet:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - d. Name of Contractor.
 - e. Name of firm or entity that prepared submittal.
 - f. Name of subcontractor.
 - g. Name of supplier.
 - h. Name of manufacturer.
 - i. Number and title of appropriate Specification Section.
 - j. Drawing number and detail references, as appropriate.
 - k. Location(s) where product is to be installed, as appropriate.
 - l. Related physical samples submitted directly.
 - m. Other necessary identification.
- F. Options: Identify options requiring selection by the Contracting Officer.
- G. Deviations: Identify deviations from the Contract Documents on submittals.
- H. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Contracting Officer observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
 - 1. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Contracting Officer.
 - 2. Submit additional copies as requested by Contracting Officer for use in review and coordination of submittals.
 - 3. Additional copies for the contractor, subcontractors, vendors, suppliers and others, upon acceptance of submittals shall be the responsible of each. All copies shall be made from approved submittals showing project approval stamp and corresponding annotations.
- I. Transmittal: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Contracting Officer will return submittals, without review, received from sources other than Contractor.

1. Transmittal Form: Provide locations on form for the following information:
 - a. Project name and number.
 - b. Date.
 - c. Destination (To:).
 - d. Source (From:).
 - e. Names of subcontractor, manufacturer, and supplier.
 - f. Category and type of submittal.
 - g. Submittal purpose and description.
 - h. Specification Section number and title.
 - i. Indication of full or partial submittal.
 - j. Drawing number and detail references, as appropriate.
 - k. Transmittal number, numbered consecutively.
 - l. Submittal and transmittal distribution record.
 - m. Remarks.
 - n. Signature of transmitter.
 2. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Contracting Officer on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- J. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
- K. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- L. Use for Construction: Use only final submittals that are marked with approval notation from Architect's /Engineer's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
1. Transmit electronic submittals as PDF electronic files directly to Contracting Officer on transportable re-usable digital file media, such as DVD or CD Disk, memory stick, etc., along with a minimum of (1) paper copy as noted herein.
 - a. Contracting Officer will return annotated paper copy or electronic file in PDF format. Contracting Officer will annotate and retain one copy of PDF file as an electronic Project record document file.

2. Action Submittals: Submit one (1) paper copies of each submittal, unless otherwise indicated. Contracting Officer may not return paper copy.
 3. Informational Submittals: Submit one (1) paper copy of each submittal, unless otherwise indicated. Contracting Officer may not return paper copy.
 4. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division 01 Section "Closeout Procedures."
 5. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 - a. Provide a notarized statement on original paper copy certificates and certifications where indicated.
 6. Test and Inspection Reports Submittals: Comply with requirements specified in Division 01 Section "Quality Requirements."
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams showing factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 5. Submit Product Data before or concurrent with Samples.
 6. Submit Product Data in the following format:
 - a. PDF electronic file.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.

- c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
 2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least (8-1/2 by 11 inches) but no larger than (30 by 42 inches).
 3. Submit Shop Drawings in the following format:
 - a. PDF electronic file.
 - b. One opaque (bond) copies of each submittal.
 - c. Contracting Officer will return electronic copy.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
 1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 2. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of applicable Specification Section.
 3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit one (1) full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Contracting Officer will return submittal with options selected.
 5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit two sets of Samples. Contracting Officer will retain one (1) Sample sets; remainder will be returned.

- 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three (3) sets of paired units that show approximate limits of variations.
- E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product.
 2. Manufacturer and product name, and model number if applicable.
 3. Number and name of room or space.
 4. Location within room or space.
 5. Submit product schedule in the following format:
 - a. PDF electronic file.
- F. Coordination Drawings: Comply with requirements specified in Division 01 Section "Project Management and Coordination."
- G. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- H. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on American Welding Society (AWS) forms. Include names of firms and personnel certified.
- I. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- J. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- K. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- L. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- M. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- N. Product Test Reports: Submit written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

- O. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
1. Name of evaluation organization.
 2. Date of evaluation.
 3. Time period when report is in effect.
 4. Product and manufacturers' names.
 5. Description of product.
 6. Test procedures and results.
 7. Limitations of use.
- P. Schedule of Tests and Inspections: Comply with requirements specified in Division 01 Section "Quality Requirements."
- Q. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- R. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- S. Field Test Reports: Submit reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- T. Maintenance Data: Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."
- U. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Contracting Officer.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally-signed PDF electronic file of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Contracting Officer.
- B. Project Closeout and Maintenance/Material Submittals: Refer to requirements in Division 01 Section "Closeout Procedures."
- C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name, number, and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 CONTRACTING OFFICER'S ACTION

- A. General: Contracting Officer will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Contracting Officer will review each submittal, make marks to indicate corrections or modifications required, and return it. Contracting Officer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
- C. Informational Submittals: Contracting Officer will review each submittal and will not return it, or will return it if it does not comply with requirements. Contracting Officer will forward each submittal to appropriate party.
- D. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Contracting Officer.
- E. Incomplete submittals are not acceptable, will be considered nonresponsive, and will be returned without review.
- F. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 01 3300

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and quality-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Mockups: Full size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
- D. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- E. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

- F. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- H. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
 - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade or trades.
- I. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

- A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 INFORMATIONAL SUBMITTALS

- A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.
- B. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- C. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Entity responsible for performing tests and inspections.
 - 3. Description of test and inspection.
 - 4. Identification of applicable standards.
 - 5. Identification of test and inspection methods.
 - 6. Number of tests and inspections required.
 - 7. Time schedule or time span for tests and inspections.
 - 8. Requirements for obtaining samples.
 - 9. Unique characteristics of each quality-control service.

1.6 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.
- B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- D. Testing and Inspection: Include in quality-control plan a comprehensive schedule of Work requiring testing or inspection, including the following:
 - 1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
 - 2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
 - 3. Owner-performed tests and inspections indicated in the Contract Documents.
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.
- F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.7 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, and telephone number of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.
 - 8. Complete test or inspection data.
 - 9. Test and inspection results and an interpretation of test results.
 - 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.

12. Name and signature of laboratory inspector.
 13. Recommendations on retesting and reinspecting.
- B. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of factory-authorized service representative making report.
 2. Statement that equipment complies with requirements.
 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 4. Statement whether conditions, products, and installation will affect warranty.
 5. Other required items indicated in individual Specification Sections.
- C. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.
- 1.8 QUALITY ASSURANCE
- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.
- F. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.
1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- G. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation

of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

- H. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
 - 1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
 - 2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
 - 3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at the Project.
 - 4. Demonstrate the proposed range of aesthetic effects and workmanship.
 - 5. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
 - a. Allow seven days for initial review and each re-review of each mockup.
 - 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 7. Demolish and remove mockups when directed, unless otherwise indicated.

1.9 QUALITY CONTROL

- A. Contractor Responsibilities: Tests and inspections are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
 - 1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 - 2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - 3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
 - 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 - 5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 - 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- B. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures."
- C. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and

conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

- D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- E. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
 - 1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 - 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 - 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 - 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 - 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 - 6. Do not perform any duties of Contractor.
- F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
 - 1. Access to the Work.
 - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 - 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 - 4. Facilities for storage and field curing of test samples.
 - 5. Delivery of samples to testing agencies.
 - 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 - 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
 - 1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- H. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of the Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses. .
 - 1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.10 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as follows:
1. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 2. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
 3. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 4. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 5. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Architect.
 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Division 01 Section "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 4000

SECTION 01 4200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

- A. General Explanation: A substantial amount of specification language constitutes definitions for terms found in other contract documents, including the drawings which must be recognized as diagrammatic in nature and not completely descriptive of requirements indicated thereon. Certain terms used in the contract documents are defined generally in this article. Definitions and explanations of this section are not necessarily either complete or exclusive, but are general for the work to extent not stated more explicitly in another provision of the contract documents.
 - 1. These specifications are of an abbreviated form and contain incomplete sentences. Omissions of words or phrases such as "the Contractor shall," "as noted on the Drawings," "according to the Drawings," "a," "an," "the" and "all" are intentional. Omitted words and phrases shall be supplied by inference in the same manner as when a "note" occurs on the Drawings.
- B. General Requirements: The provisions or requirements of Division 1 sections. General Requirements apply to entire work of Contract and, where so indicated, to other elements of work which are included in the project.
 - 1. In case of conflict between the General Conditions and the General Requirements, the General Requirements shall govern this Contract.
- C. Indicated: The term "indicated" is a cross-reference to details, notes or schedules on the drawings, and to similar means of recording requirements in the contract documents. Where terms such as "shown", "noted", "scheduled", and "specified" are used in lieu of "indicated", it is for purpose of helping reader locate cross-reference, and no limitation of location is intended except as specifically noted.
- D. Directed, Requested, etc.: Where not otherwise explained, terms such as "directed", "requested", "authorized", "selected", "approved", "required", "accepted", and "permitted" mean "directed by Architect", "requested by Architect", etc. However, no such implied meaning will be interpreted to extend Architect's responsibility into Contractor's area of construction supervision.
- E. Approve: Where used in conjunction with Architect's response to submittals, requests, applications, inquiries, reports and claims by Contractor, the meaning of term "approved" will be held to limitations of Architect's responsibilities and duties as specified in General and Supplementary Conditions. In no case will "approval" by Architect be interpreted as a release of Contractor from responsibilities to fulfill requirements of the contract documents.
- F. Furnish: Except as otherwise defined in greater detail, term "furnish" is used to mean supply and deliver to project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

- G. Install: Except as otherwise defined in greater detail, term "install" is used to describe operations at project site including unloading, unpacking, assembly, erection, placing, connecting, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations, as applicable in each instance.
- H. Provide: Except as otherwise defined in greater detail, term "provide" means furnish and install, complete and ready for intended use, as applicable in each instance.
- I. Installer: The entity (person or firm) engaged by the Contractor or its subcontractor or sub-subcontractor for the performance of a particular unit of work at the project site, including installation, erection, application and similar required operations. It is a general requirement that such entities (Installers) be expert in operations they are engaged to perform.
- J. Unless otherwise indicated, a detail indicates the general application of work at all locations where it logically applies.
- K. Overlapping and Conflicting Requirements: Where compliance with 2 or more industry standards or sets of requirements is specified, and overlapping of those different standards or requirements establishes different or conflicting minimums or levels of quality, the most stringent requirement is intended. Refer apparently-equal-but-different requirements, and uncertainties as to which level of quality is more stringent, to Architect/Engineer for a decision before proceeding.
- L. Minimum Quality/Quantity: In every instance, quality level or quantity shown or specified is intended as minimum for the work to be performed or provided. Except as otherwise specifically indicated, actual work may either comply exactly with that minimum (within specified tolerances), or may exceed that minimum within reasonable limits. In complying with requirements, indicated numeric values are either minimums or maximums as noted or as appropriate for context of requirements. Refer instances of uncertainty to Architect/Engineer for decision before proceeding.

1.3 INDUSTRY STANDARDS

- A. General Applicability of Standards: Applicable standards of construction industry have same force and effect (and are made a part of contract documents by reference) as if copied directly into contract documents, or as if published copies were bound herewith.
- B. Reference standards (referenced directly in contract documents or by governing regulations) have precedence over non-referenced standards which are recognized in industry for applicability to work.
- C. Publication Dates: Except as otherwise indicated, where compliance with an industry standard is required, comply with standard in effect as of date of contract documents.
- D. Reference to technical society, organization or body is made in specifications in accordance with abbreviations listed in the Reference Standards Article of the General Conditions of the Contract.

1.4 GOVERNING REGULATIONS

- A. Codes, Rules and Regulations: The project has been designed and shall be constructed to comply with applicable sections of the following codes, rules and regulations. Except as otherwise indicated, comply with editions and supplements in effect as of date of contract documents. Other required compliances are noted elsewhere in the Contract Documents.

- 1. Building Codes:

- a. International Building Code (ICBO), 2009 ed.
 - b. International Mechanical Code (ICBO), 2009 ed.
 - c. International Plumbing Code (ICBO), 2012 ed.
 - d. National Electrical Code (NFPA-70), Current Edition.
 - e. International Fire Code, 2009 ed.
 - f. International Energy Conservation Code, 2009 ed.
2. Safety Codes:
- a. National Electrical Safety Code (NBS-Handbook H30)
 - b. Occupational Safety & Health Standard (OSHA)
3. National Fire Codes:
- a. NFPA-13, 2010 ed.
 - b. NFPA-24, 2010 ed.
 - c. NFPA-54 Gas Appliance and Piping Installation
 - d. NFPA-89M Clearances, Heat Producing Appliances
 - e. NFPA-90A Air Conditioning/Ventilating Systems
 - f. NFPA-91 Blower and Exhaust System
 - g. NFPA-101 Life Safety Code
 - h. NFPA-204 Smoke and Heating Vent Guide
 - i. UFC 3-600-01, Sept. 2006, incl change 3, March 2013.
4. Underwriters Laboratories Inc.:
- a. All materials, equipment and component parts of equipment shall bear UL labels whenever such devices are listed by UL.
5. Handicapped Accessibility Standards:
- a. Americans With Disabilities Act Accessibility Guidelines (ADAAG)
 - b. Architectural Barriers Act (ABA)
 - c. ANSI 117.1 – Handicapped Accessibility
- B. Storm Water Discharge: Comply with Environmental Protection Agency (EPA) regulations and provisions of the Federal Water Pollution Control Act for control of storm water discharges associated with any construction activity.
- C. Submittals: For the Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, and similar documents, correspondence and records established in conjunction with compliance with standards and regulations bearing upon performance of the work.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 4200

SECTION 015000 – TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes requirements for temporary facilities and controls, including temporary utilities, support facilities, and security and protection facilities.

- B. Temporary utilities include, but are not limited to, the following:

1. Sewers and drainage.
2. Water service and distribution.
3. Sanitary facilities, including toilets, wash facilities, and drinking-water facilities.
4. Heating and cooling facilities.
5. Ventilation.
6. Electric power service.
7. Lighting.
8. Telephone service.

- C. Support facilities include, but are not limited to, the following:

1. Project identification and temporary signs.
2. Waste disposal facilities.
3. Field offices.
4. Storage and fabrication sheds.
5. Lifts and hoists.
6. Temporary stairs.
7. Construction aids and miscellaneous services and facilities.

- D. Security and protection facilities include, but are not limited to, the following:

1. Environmental protection.
2. Stormwater control.
3. Tree and plant protection.
4. Pest control.
5. Site enclosure fence.
6. Security enclosure and lockup.
7. Barricades, warning signs, and lights.
8. Covered walkways.
9. Temporary enclosures.
10. Temporary partitions.
11. Fire protection.

- E. Related Sections include the following:

1. Division 1 Section "Execution" for progress cleaning requirements.

2. Division 31 Section "Termite Control" for pest control.
3. Divisions 2 through 34 for temporary heat, ventilation, and humidity requirements for products in those Sections.

1.3 DEFINITIONS

- A. Permanent Enclosure: As determined by Architect, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.

1.4 USE CHARGES

- A. General: Cost or use charges for temporary facilities are not chargeable to Owner or Architect and shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, the following:
 1. Owner's construction forces.
 2. Occupants of Project.
 3. Architect.
 4. Testing agencies.
 5. Personnel of authorities having jurisdiction.
- B. Water Service: The Government shall provide water as necessary for construction work and as available based on location and capacity at no cost to the contractor. The contractor is responsible for tapping into existing lines at locations specified by the Base Civil Engineer.
- C. Electric Power Service: The Government shall provide all electricity as necessary for construction work and as available based on location and capacity at no cost to the contractor. The contractor is responsible for tapping into existing lines at locations specified by the Base Civil Engineer.
- D. Should permanent systems not be available it is Contractor's responsibility to provide required utilities.

1.5 QUALITY ASSURANCE

- A. Standards: Comply with ANSI A10.6, NECA's "Temporary Electrical Facilities," and NFPA 241.
 1. Trade Jurisdictions: Assigned responsibilities for installation and operation of temporary utilities are not intended to interfere with trade regulations and union jurisdictions.
 2. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.6 PROJECT CONDITIONS

- A. Temporary Utilities: At earliest feasible time, change over from use of temporary service to use of permanent service.
 1. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent

service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

- B. Conditions of Use: The following conditions apply to use of temporary services and facilities by all parties engaged in the Work:
1. Keep temporary services and facilities clean and neat.
 2. Relocate temporary services and facilities as required by progress of the Work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide new materials. Undamaged, previously used materials in serviceable condition may be used if approved by Architect. Provide materials suitable for use intended.
- B. Portable Chain-Link Fencing: Minimum 2-inch 9-gage, galvanized steel, chain-link fabric fencing; minimum 6 feet high with galvanized steel pipe posts; minimum 2-3/8-inch OD line posts and 2-7/8-inch OD corner and pull posts, with 1-5/8-inch OD top and bottom rails. Provide concrete or steel bases for supporting posts.
- C. Lumber and Plywood: Comply with requirements in Division 6 Section "Rough Carpentry."
- D. Gypsum Board: Minimum 1/2 inch thick by 48 inches wide by maximum available lengths; regular-type panels with tapered edges. Comply with ASTM C 36.
- E. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indices of 25 and 50, respectively.
- F. Paint: Comply with requirements in Division 9 Section "Painting."
- G. Tarpaulins: Fire-resistive labeled with flame-spread rating of 15 or less.
- H. Water: Potable.

2.2 EQUIPMENT

- A. General: Provide equipment suitable for use intended.
- B. Field Offices: Mobile units with lockable entrances, operable windows, and serviceable finishes; heated and air conditioned; on foundations adequate for normal loading.
- C. Fire Extinguishers: Hand carried, portable, UL rated. Provide class and extinguishing agent as indicated or a combination of extinguishers of NFPA-recommended classes for exposures.
1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.
- D. Self-Contained Toilet Units: Single-occupant units of chemical, aerated recirculation, or combustion type; vented; fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.

- E. Drinking-Water Fixtures: Containerized, tap-dispenser, bottled-water drinking-water units, including paper cup supply.
- F. Heating Equipment: Unless Owner authorizes use of permanent heating system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Heating Units: Listed and labeled, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use for type of fuel being consumed.
 - 3. Verify temporary heating equipment fumes will not impair quality of finish installation. Damaged finishes due to heating fumes shall be removed and replaced at Contractors expense.
- G. Electrical Outlets: Properly configured, NEMA-polarized outlets to prevent insertion of 110- to 120-V plugs into higher-voltage outlets; equipped with ground-fault circuit interrupters, reset button, and pilot light.
- H. Power Distribution System Circuits: Where permitted and overhead and exposed for surveillance, wiring circuits, not exceeding 125-V ac, 20-A rating, and lighting circuits may be nonmetallic sheathed cable.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.
- B. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Engage appropriate local utility company to install temporary service or connect to existing service. Where utility company provides only part of the service, provide the remainder with matching, compatible materials and equipment. Comply with utility company recommendations.
 - 1. Arrange with utility company to make connections for temporary services.
 - 2. Provide adequate capacity at each stage of construction. Before temporary utility is available, provide trucked-in services.
 - 3. Obtain easements to bring temporary utilities to Project site where Owner's easements cannot be used for that purpose.
- B. Sewers and Drainage: If sewers are available, provide temporary connections to remove effluent that can be discharged lawfully. If sewers cannot be lawfully used for discharge of effluent, provide containers to remove and dispose of effluent off-site in a lawful manner.

1. Filter out excessive soil, construction debris, chemicals, oils, and similar contaminants that might clog sewers or pollute waterways before discharge.
 2. Connect temporary sewers to municipal system or private system as directed by sewer department officials.
 3. Maintain temporary sewers and drainage facilities in a clean, sanitary condition. After heavy use, restore normal conditions promptly.
 4. Provide temporary filter beds, settlement tanks, separators, and similar devices to purify effluent to levels acceptable to authorities having jurisdiction.
- C. Water Service: Contractor will be responsible for all costs associated with connections to existing service. At project completion, restore these facilities to condition existing before initial use.
1. Provide rubber hoses as necessary to serve Project site.
 2. As soon as water is required, extend service to form a temporary water distribution system. Provide yard hydrant and hose bib connections so that all areas of new construction can be reached with a 100-foot hose.
 3. Where installations below an outlet might be damaged by spillage or leakage, provide a drip pan of suitable size to minimize water damage. Drain accumulated water promptly from pans.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking-water fixtures. Comply with regulations and health codes for type, number, location, operation, and maintenance of fixtures and facilities.
1. Disposable Supplies: Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Maintain adequate supply. Provide covered waste containers for disposal of used material.
 2. Toilets: Use of new construction toilet facilities will not be permissible. Install self-contained toilet units. Shield toilets to ensure privacy. Provide separate facilities for male and female personnel.
 3. Wash Facilities: Install wash facilities supplied with potable water at convenient locations for personnel who handle materials that require wash up. Dispose of drainage properly. Supply cleaning compounds appropriate for each type of material handled.
 - a. Provide safety showers, eyewash fountains, and similar facilities for convenience, safety, and sanitation of personnel.
 4. Drinking-Water Facilities: Provide bottled-water, drinking-water units.
- E. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment from that specified that will not have a harmful effect on completed installations or elements being installed.
1. Maintain a minimum temperature of 45 deg F in permanently enclosed portions of building for normal construction activities, and 55 deg F for finishing activities and areas where finished Work has been installed.
- F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment from that specified that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

- G. Electric Distribution: Provide receptacle outlets adequate for connection of power tools and equipment.
1. Provide waterproof connectors to connect separate lengths of electrical power cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage ratio.
 2. Provide warning signs at power outlets other than 110 to 120 V.
 3. Provide metal conduit, tubing, or metallic cable for wiring exposed to possible damage. Provide rigid steel conduits for wiring exposed on grades, floors, decks, or other traffic areas.
 4. Provide metal conduit enclosures or boxes for wiring devices.
 5. Provide 4-gang outlets, spaced so 100-foot extension cord can reach each area for power hand tools and task lighting. Provide a separate 125-V ac, 20-A circuit for each outlet.
- H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations and traffic conditions.
1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
 2. Install exterior-yard site lighting that will provide adequate illumination for construction operations, traffic conditions, and signage visibility when the Work is being performed.
- I. Telephone Service: Provide temporary telephone service throughout construction period for common-use facilities used by all personnel engaged in construction activities. Install separate telephone line for each field office and first-aid station. All telephone service will be at Contractor's expense.
1. Provide additional telephone lines for the following:
 - a. Provide a dedicated telephone line for each facsimile machine and computer with modem in each field office.
 2. At each telephone, post a list of important telephone numbers.
 - a. Police and fire departments.
 - b. Ambulance service.
 3. Provide an answering machine or voice-mail service on superintendent's telephone.
 4. Provide e-mail service for project superintendent.

3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
1. Locate field offices, storage sheds, sanitary facilities, and other temporary construction and support facilities for easy access.
 2. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet of building lines. Comply with NFPA 241.
 3. Maintain support facilities until near Substantial Completion. Remove at Substantial Completion. Personnel remaining after Substantial Completion will not be permitted to use permanent facilities, unless arrangements are made with the Owner's Representative.

- B. **Project Identification and Temporary Signs:** Prepare Project identification and other signs in sizes approved by the Owner. Install project identification sign where directed by the Architect to inform public and persons seeking entrance to Project. Provide directional signs at locations required to effectively direct traffic to or around construction site. Provide directional signs of similar construction and graphics to project sign or of standard painted metal and metal stakes. Signs shall be approximately 4 S.F. each. Do not permit installation of unauthorized signs.
- C. **Waste Disposal Facilities:** Provide waste-collection containers in sizes adequate to handle waste from construction operations. Containerize and clearly label hazardous, dangerous, or unsanitary waste materials separately from other waste. Comply with Division 1 Section "Execution" for progress cleaning requirements.
 - 1. If required by authorities having jurisdiction, provide separate containers, clearly labeled, for each type of waste material to be deposited.
 - 2. Develop a waste management plan for Work performed on Project. Indicate types of waste materials Project will produce and estimate quantities of each type. Provide detailed information for on-site waste storage and separation of recyclable materials. Provide information on destination of each type of waste material and means to be used to dispose of all waste materials.
 - 3. Coordinate ALL waste disposal with LEED requirements.
- D. **Storage and Fabrication Sheds:** Provide sheds sized, furnished, and equipped to accommodate materials and equipment involved, including temporary utility services. Sheds may be open shelters or fully enclosed spaces within building or elsewhere on-site.
 - 1. All storage and fabrication structures must be pre approved by the Owner and Architect.
- E. **Lifts and Hoists:** Provide facilities for hoisting materials and personnel. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- F. **Temporary Stairs:** Until permanent stairs are available, provide temporary stairs where ladders are not adequate. Cover finished, permanent stairs with protective covering of plywood or similar material so finishes will be undamaged at time of acceptance.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. **Environmental Protection:** Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects. Avoid using tools and equipment that produce harmful noise. Restrict use of noisemaking tools and equipment to hours that will minimize complaints from persons or firms near Project site.
- B. **Stormwater Control:** Provide earthen embankments and similar barriers in and around excavations and subgrade construction, sufficient to prevent flooding by runoff of stormwater from heavy rains.
- C. **Tree and Plant Protection:** Comply with requirements in Division 31 Section "Tree Protection."
- D. **Pest Control:** Before deep foundation work has been completed, retain a local exterminator or pest-control company to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests. Engage this pest-control service to perform extermination and control

procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Obtain extended warranty for Owner. Perform control operations lawfully, using environmentally safe materials.

- E. Site Enclosure Fencing: Before construction operations begin, install portable chain-link enclosure fencing with lockable entrance gates. Locate to accommodate construction operations. Install in a manner that will prevent people, dogs, and other animals from easily entering site except by entrance gates.
 - 1. Set fence posts in concrete or steel bases.
 - 2. Provide gates in sizes and at locations necessary to accommodate delivery vehicles and other construction operations.
 - 3. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Provide Owner with one set of keys.
- F. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.
- G. Barricades, Warning Signs, and Lights: Comply with standards and code requirements for erecting structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and public of possible hazard. Where appropriate and needed, provide lighting, including flashing red or amber lights.
 - 1. For safety barriers, sidewalk bridges, and similar uses, provide minimum 5/8-inch thick exterior plywood.
- H. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is not complete, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.
 - 2. Vertical Openings: Close openings of 25 sq. ft. or less with plywood or similar materials.
 - 3. Horizontal Openings: Close openings in floor or roof decks and horizontal surfaces with load-bearing, wood-framed construction.
 - 4. Install tarpaulins securely using fire-retardant-treated wood framing and other materials.
 - 5. Where temporary wood or plywood enclosure exceeds 100 sq. ft. in area, use fire-retardant-treated material for framing and main sheathing.
- I. Temporary Fire Protection: Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
 - 1. Provide fire extinguishers, installed on walls on mounting brackets, visible and accessible from space being served, with sign mounted above.
 - a. Field Offices: Class A stored-pressure water-type extinguishers.
 - b. Other Locations: Class ABC dry-chemical extinguishers or a combination of extinguishers of NFPA-recommended classes for exposures.
 - c. Locate fire extinguishers where convenient and effective for their intended purpose; provide not less than one extinguisher on each floor at or near each usable stairwell.

2. Store combustible materials in containers in fire-safe locations.
3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for firefighting. Prohibit smoking in hazardous fire-exposure areas.
4. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition.
5. Permanent Fire Protection: At earliest feasible date in each area of Project, complete installation of permanent fire-protection facility, including connected services, and place into operation and use. Instruct key personnel on use of facilities.
6. Develop and supervise an overall fire-prevention and first-aid fire-protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

3.5 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage caused by freezing temperatures and similar elements.
 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
 2. Prevent water-filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.
- C. Temporary Facility Changeover: Except for using permanent fire protection, as soon as available, do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 1. Materials and facilities that constitute temporary facilities are the property of Contractor.
 2. At Final Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements in Division 1 Section "Closeout Procedures."

END OF SECTION 01 5000

SECTION 01 6000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

1.3 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled intact from other projects are not considered new products. New products can contain recycled raw materials.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.4 ACTION SUBMITTALS

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
 - 2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
 - a. Form of Approval: As specified in Division 01 Section "Submittal Procedures."

- b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

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

1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

- B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

- C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
3. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
4. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
5. Protect stored products from damage and liquids from freezing.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 2. Refer to Divisions 02 through 49. Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Division 01 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 4. Where products are accompanied by the term "as selected," Architect will make selection.
 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
- B. Product Selection Procedures:
1. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 2. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 3. Evidence that proposed product provides specified warranty.

4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 6000

SECTION 01 7300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Coordination of Owner-installed products.
 - 5. Progress cleaning.
 - 6. Starting and adjusting.
 - 7. Protection of installed construction.

1.3 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For land surveyor.
- B. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.

1.5 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.

1. For projects requiring compliance with sustainable design and construction practices and procedures, utilize products for patching that comply with requirements of Division 01 Section "Sustainable Design Requirements."
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to the Architect for visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
- B. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of the Contractor, submit a request for information to Architect according to requirements in Division 01 Section "Project Management and Coordination."

- E. Surface and Substrate Preparation: Comply with manufacturer's recommendations for preparation of substrates to receive subsequent work.

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
 - 1. Establish benchmarks and control points to set lines and levels of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 3. Inform installers of lines and levels to which they must comply.
 - 4. Check the location, level and plumb, of every major element as the Work progresses.
 - 5. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
 - 6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

- A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- B. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 1. Make vertical work plumb and make horizontal work level.
 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
 4. Maintain minimum headroom clearance of 96 inches (2440 mm) in occupied spaces and 90 inches (2300 mm) in unoccupied spaces.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Final Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- G. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect or allowed by applicable codes.
 2. Allow for building movement, including thermal expansion and contraction.
 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction personnel.

- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.
 - 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.

3.7 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).
 - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Utilize containers intended for holding waste materials of type to be stored.
 - 4. Coordinate progress cleaning for joint-use areas where more than one installer has worked.
- B. Site: Maintain Project site free of waste materials and debris at all times. Keep site mowed to a maximum height of 6" at all times.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways.
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Final Completion.

- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: Comply with qualification requirements in Division 01 Section "Quality Requirements."

3.9 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Final Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 01 7300

SECTION 01 7419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Recycling Requirements: This project shall meet the requirements of Army regulation 420-1, 12 Feb, 08 subject: "Army Facilities Management" and DAIMOD, 27 Mar., 09, Subject: FY09 Solid Waste Annual Reporting (SWAReb) schedule regarding recycling of Construction and Demolition waste.
- B. Section includes administrative and procedural requirements for the following:
 - 1. Salvaging nonhazardous demolition and construction waste.
 - 2. Recycling nonhazardous demolition and construction waste.
 - 3. Disposing of nonhazardous demolition and construction waste.

1.3 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Achieve end-of-Project rates for salvage/recycling of 75 percent by weight of total non-hazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials, including but not limited to the following:

1. Demolition Waste:
 - a. Concrete.
 - b. Concrete reinforcing steel.
 - c. Brick.
 - d. Concrete masonry units.
 - e. Wood studs.
 - f. Wood joists.
 - g. Plywood and oriented strand board.
 - h. Wood paneling.
 - i. Wood trim.
 - j. Structural and miscellaneous steel.
 - k. Rough hardware.
 - l. Roofing.
 - m. Insulation.
 - n. Doors and frames.
 - o. Door hardware.
 - p. Windows.
 - q. Glazing.
 - r. Metal studs.
 - s. Gypsum board.
 - t. Acoustical tile and panels.
 - u. Equipment.
 - v. Cabinets.
 - w. Plumbing fixtures.
 - x. Piping.
 - y. Supports and hangers.
 - z. Valves.
 - aa. Mechanical equipment.
 - bb. Refrigerants.
 - cc. Electrical conduit.
 - dd. Copper wiring.
 - ee. Lighting fixtures.
 - ff. Lamps.
 - gg. Ballasts.
 - hh. Electrical devices.
 - ii. Switchgear and panelboards.
 - jj. Transformers.

2. Construction Waste:
 - a. Masonry and CMU.
 - b. Lumber.
 - c. Wood sheet materials.
 - d. Wood trim.
 - e. Metals.
 - f. Roofing.
 - g. Insulation.
 - h. Gypsum board.
 - i. Piping.
 - j. Electrical conduit.
 - k. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
 - 1) Paper.

- 2) Cardboard.
- 3) Boxes.
- 4) Plastic sheet and film.
- 5) Polystyrene packaging.
- 6) Wood crates.
- 7) Plastic pails.

1.5 ACTION SUBMITTALS

- A. Waste Management Plan: Submit Contractor's Construction Waste and Recycling Plan (Att. A) within 7 days of date established for commencement of the Work. Waste Management Plan to follow all applicable requirements for LEED.

1.6 INFORMATIONAL SUBMITTALS

- A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Use Contractor's Reuse, Recycling, and Disposal Report (Att. B). The Plan must include, but is not limited to the following information:
 1. Contractor's name and project identification information.
 2. Generation point of waste.
 3. Procedures to be used.
 4. Names and locations of re-use and recycling facilities/sites.
 5. Total quantity of waste in tons (tonnes).
 6. Quantity of waste salvaged, both estimated and actual in tons (tonnes).
 7. Quantity of waste recycled, both estimated and actual in tons (tonnes).
 8. Total quantity of waste recovered (salvaged plus recycled) in tons (tonnes).
 9. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
- B. Waste Reduction Calculations: Before request for Final Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- C. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
- D. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- E. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- F. Qualification Data: For refrigerant recovery technician.
- G. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.7 QUALITY ASSURANCE

- A. Waste Management Coordinator Qualifications: Experienced firm, with a record of successful waste management coordination of projects with similar requirements, that employs a LEED-Accredited Professional, certified by the USGBC, as waste management coordinator.
- B. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.
- C. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
- D. Waste Management Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
 - 1. Review and discuss waste management plan including responsibilities of waste management coordinator.
 - 2. Review requirements for documenting quantities of each type of waste and its disposition.
 - 3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
 - 4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
 - 5. Review waste management requirements for each trade.

1.8 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan according to ASTM E 1609 and requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
- B. Waste Identification: Indicate anticipated types and quantities of demolition and construction waste generated by the Work. Use Contractor's Reuse, Recycling, and Disposal Report (Att. B). Include estimated quantities and assumptions for estimates.
- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Use Contractor's Construction waste and Recycling Plan. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
 - 1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
 - 2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
 - 3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
 - 4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
 - 5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.

6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.
- D. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Include the following:
1. Total quantity of waste.
 2. Estimated cost of disposal (cost per unit). Include hauling and tipping fees and cost of collection containers for each type of waste.
 3. Total cost of disposal (with no waste management).
 4. Revenue from salvaged materials.
 5. Revenue from recycled materials.
 6. Savings in hauling and tipping fees by donating materials.
 7. Savings in hauling and tipping fees that are avoided.
 8. Handling and transportation costs. Include cost of collection containers for each type of waste.
 9. Net additional cost or net savings from waste management plan.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
1. Comply with operation, termination, and removal requirements in Division 01 Section "Temporary Facilities and Controls."
- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan.
- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
1. Distribute waste management plan to everyone concerned within three days of submittal return.
 2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
 2. Comply with Division 01 Section "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall be represented in bid documents.
- C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
 - 1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination and remove contaminated materials if found.
 - 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 - 4. Store components off the ground and protect from the weather.
 - 5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor.

3.3 RECYCLING DEMOLITION WASTE

- A. Asphalt Paving: Grind asphalt to maximum 4-inch (100-mm) size.
 - 1. Crush asphaltic concrete paving and screen to comply with requirements in Division 31 Section "Earth Moving" for use as general fill.
- B. Asphalt Paving: Break up and transport paving to asphalt-recycling facility.
- C. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
 - 1. Pulverize concrete to maximum 4-inch (100-mm) size.
 - 2. Crush concrete and screen to comply with requirements in Division 31 Section "Earth Moving" for use as satisfactory soil for fill or subbase.
- D. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
 - 1. Pulverize masonry to maximum 4-inch (100-mm) size.
 - a. Crush masonry and screen to comply with requirements in Division 31 Section "Earth Moving" for use as general fill.
 - b. Crush masonry and screen to comply with requirements in Division 32 Section "Plants" for use as mineral mulch.

2. Clean and stack undamaged, whole masonry units on wood pallets.
- E. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
- F. Metals: Separate metals by type.
 1. Structural Steel: Stack members according to size, type of member, and length.
 2. Remove and dispose of bolts, nuts, washers, and other rough hardware.
- G. Asphalt Shingle Roofing: Separate organic and glass-fiber asphalt shingles and felts. Remove and dispose of nails, staples, and accessories.
- H. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.
- I. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.
- J. Metal Suspension System: Separate metal members including trim, and other metals from acoustical panels and tile and sort with other metals.
- K. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.
- L. Conduit: Reduce conduit to straight lengths and store by type and size.

3.4 RECYCLING CONSTRUCTION WASTE

- A. Packaging:
 1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
 2. Polystyrene Packaging: Separate and bag materials.
 3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
 4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- B. Wood Materials:
 1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
 2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
- C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.
 1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

3.5 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.
- C. Disposal: Remove waste materials and dispose of at designated spoil areas on Owner's property.
- D. Disposal: Remove waste materials from Owner's property and legally dispose of them.

END OF SECTION 01 7419

SECTION 01 7700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Final completion procedures.
 - 2. Warranties.
 - 3. Final cleaning.

1.3 FINAL COMPLETION

- A. Final Procedures: Before requesting inspection for determining date of Final Completion, complete the following. List items below that are incomplete with request.
 - 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
 - 2. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 3. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 4. Prepare and submit Project Record Documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
 - 5. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
 - 6. Complete startup testing of systems.
 - 7. Submit test/adjust/balance records.
 - 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 - 9. Advise Owner of changeover in heat and other utilities.
 - 10. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
 - 11. Complete final cleaning requirements, including touchup painting.
 - 12. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
 - 13. Submit a final Application for Payment according to the General Conditions of the Contract.
 - 14. Submit certified copy of Architect's Final Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 - 15. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

16. Submit completed Final Commissioning Report.

1.4 LIST OF INCOMPLETE ITEMS (PUNCH LIST) BY CONTRACTOR

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction. Use CSI Form 14.1A.
1. Organize list of spaces in sequential order, starting with exterior areas first.
 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Contractor.
 - d. Page number.
 4. Submit list of incomplete items in the following format:
 - a. PDF electronic file.

1.5 WARRANTIES

- A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Final Completion is indicated.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (215-by-280-mm) paper.
 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
 4. Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide table of contents at beginning of document.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
 - 1. Use cleaning products that meet Green Seal GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Final Completion for entire Project or for a portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Sweep concrete floors broom clean in unoccupied spaces.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
 - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - k. Remove labels that are not permanent.
 - l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.

- 1) Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates.
- m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
- n. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
- o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
- p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
- q. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter upon inspection.
- 1) Clean HVAC system in compliance with NADCA Standard 2005 edition. Provide written report upon completion of cleaning.
- r. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
- s. Leave Project clean and ready for occupancy.

END OF SECTION 01 7700

SECTION 01 7823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory.
 - 2. Emergency manuals.
 - 3. Operation manuals for systems, subsystems, and equipment.
 - 4. Product maintenance manuals.
 - 5. Systems and equipment maintenance manuals.
- B. Related Requirements:
 - 1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.3 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

- A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect and Commissioning Authority will comment on whether content of operations and maintenance submittals are acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operations and maintenance manuals in the following format:
 - 1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.

- a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
 - b. Enable inserted reviewer comments on draft submittals.
2. Three paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Architect will return two copies.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect and Commissioning Authority will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Authority will return copy with comments.
1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:
1. List of documents.
 2. List of systems.
 3. List of equipment.
 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
1. Title page.
 2. Table of contents.
 3. Manual contents.
- B. Title Page: Include the following information:
1. Subject matter included in manual.
 2. Name and address of Project.
 3. Name and address of Owner.
 4. Date of submittal.
 5. Name and contact information for Contractor.
 6. Name and contact information for Construction Manager.
 7. Name and contact information for Architect.
 8. Name and contact information for Commissioning Authority.
 9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- F. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.
1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm)

paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

- a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.
2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
 4. Supplementary Text: Prepared on 8-1/2-by-11-inch (215-by-280-mm) white bond paper.
 5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for each of the following:
 1. Type of emergency.
 2. Emergency instructions.
 3. Emergency procedures.
- B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
 1. Fire.
 2. Flood.
 3. Gas leak.
 4. Water leak.
 5. Power failure.
 6. Water outage.
 7. System, subsystem, or equipment failure.
 8. Chemical release or spill.
- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

2.4 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 2. Performance and design criteria if Contractor has delegated design responsibility.
 3. Operating standards.
 4. Operating procedures.
 5. Operating logs.
 6. Wiring diagrams.
 7. Control diagrams.
 8. Piped system diagrams.
 9. Precautions against improper use.
 10. License requirements including inspection and renewal dates.
- B. Descriptions: Include the following:
1. Product name and model number. Use designations for products indicated on Contract Documents.
 2. Manufacturer's name.
 3. Equipment identification with serial number of each component.
 4. Equipment function.
 5. Operating characteristics.
 6. Limiting conditions.
 7. Performance curves.
 8. Engineering data and tests.
 9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
 2. Equipment or system break-in procedures.
 3. Routine and normal operating instructions.
 4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.5 PRODUCT MAINTENANCE MANUALS

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Product Information: Include the following, as applicable:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Color, pattern, and texture.
 - 4. Material and chemical composition.
 - 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 - 1. Inspection procedures.
 - 2. Types of cleaning agents to be used and methods of cleaning.
 - 3. List of cleaning agents and methods of cleaning detrimental to product.
 - 4. Schedule for routine cleaning and maintenance.
 - 5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
 - 1. Standard maintenance instructions and bulletins.

2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 3. Identification and nomenclature of parts and components.
 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
 2. Troubleshooting guide.
 3. Precautions against improper maintenance.
 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 5. Aligning, adjusting, and checking instructions.
 6. Demonstration and training video recording, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
1. Do not use original project record documents as part of operation and maintenance manuals.
 2. Comply with requirements of newly prepared record Drawings in Section 017839 "Project Record Documents."
- G. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 01 7823

SECTION 01 7839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set(s) of marked-up record prints.
- B. Record Specifications: Submit one paper copy of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit one paper copy of each submittal.
 - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings.
 - 1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding archive photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:

- a. Dimensional changes to Drawings.
- b. Revisions to details shown on Drawings.
- c. Depths of foundations below first floor.
- d. Locations and depths of underground utilities.
- e. Revisions to routing of piping and conduits.
- f. Revisions to electrical circuitry.
- g. Actual equipment locations.
- h. Duct size and routing.
- i. Locations of concealed internal utilities.
- j. Changes made following Architect's written orders.
- k. Details not on the original Contract Drawings.
- l. Field records for variable and concealed conditions.
- m. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Utilize personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
5. Note related Change Orders, record Product Data, and record Drawings where applicable.

- B. Format: Submit record Specifications as paper copy.

2.3 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 - 3. Note related Change Orders, record Specifications, and record Drawings where applicable.
- B. Format: Submit record Product Data as paper copy.
 - 1. Include record Product Data directory organized by specification section number and title, electronically linked to each item of record Product Data.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and modifications to project record documents as they occur; do not wait until the end of Project.
- B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION 01 7839

SECTION 01 7900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.

1.3 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules utilizing manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

1.4 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

1.5 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 - 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Operations manuals.
 - c. Maintenance manuals.
 - d. Project record documents.
 - e. Identification systems.
 - f. Warranties and bonds.
 - g. Maintenance service agreements and similar continuing commitments.
 - 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
 - 4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.

- k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
- a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
- a. Diagnostic instructions.
 - b. Test and inspection procedures.
7. Maintenance: Include the following:
- a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
8. Repairs: Include the following:
- a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Division 01 Section "Operations and Maintenance Data."
- B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
 2. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
1. Schedule training with Owner with at least seven days' advance notice.
- D. Demonstration and Training Video: Contractor shall record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
1. Record using digital video recording device(s).
 2. At the beginning of each training module, record each chart containing learning objective and lesson outline.
- E. Materials: Provide all handouts, books, visual aids and other informational documentation to the Owner in PDF format.
- F. Cleanup: Collect used and leftover educational materials and remove from Project site give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

END OF SECTION 01 7900

SECTION 01 8113.13 - SUSTAINABLE DESIGN REQUIREMENTS - LEED FOR NEW CONSTRUCTION AND MAJOR RENOVATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes general requirements and procedures for compliance with certain USGBC LEED prerequisites and credits needed for Project to minimally obtain LEED Gold certification based on USGBC's "LEED 2009 for New Construction & Major Renovations."
 - 1. Other LEED prerequisites and credits needed to obtain LEED certification depend on product selections and may not be specifically identified as LEED requirements. Compliance with requirements needed to obtain LEED prerequisites and credits may be used as one criterion to evaluate substitution requests and comparable product requests. Refer to "Instructions to Bidders" for requests for substitution prior to bid date.
 - 2. Additional LEED prerequisites and credits needed to obtain the indicated LEED certification depend on Architect's design and other aspects of Project that are not part of the Work of the Contract.
 - 3. A copy of the LEED Project checklist is attached at the end of this Section for information only.
- B. Related Requirements:
 - 1. Divisions 01 through 33 Sections for LEED requirements specific to the work of each of these Sections. Requirements may or may not include reference to LEED.
 - 2. Division 01 Section "Construction Waste Management and Disposal" for disposal of waste resulting from demolition and construction activities.

1.3 DEFINITIONS

- A. Chain-of-Custody Certificates: Certificates signed by manufacturers certifying that wood used to make products was obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship." Certificates shall include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.
- B. Regional Materials: Materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.

- C. Recycled Content: The recycled content value of a material assembly shall be determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value.
 - 1. "Post-consumer" material is defined as waste material generated by households or by commercial, industrial, and institutional facilities in their role as end users of the product, which can no longer be used for its intended purpose.
 - 2. "Pre-consumer" material is defined as material diverted from the waste stream during the manufacturing process. Excluded is reutilization of materials such as rework, regrind, or scrap generated in a process and capable of being reclaimed within the same process that generated it.
- D. Construction and Demolition Waste: Includes solid wastes, such as building materials, packaging, rubbish, debris, and rubble resulting from construction, and demolition operations. A construction waste management plan is to be provided by the Contractor as defined in Division 01 Section "Construction Waste Management and Disposal"
- E. LEED: The Leadership in Energy and Environmental Design green building rating systems developed and adopted by the U.S. Green Building Council (USGBC)
- F. Volatile Organic Compounds (VOCs): Any compound of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, which participates in atmospheric photochemical reactions. Compounds that have negligible photochemical reactivity, listed in EPA 40 CFR 51.100(s), are also excluded from this regulatory definition.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Respond to questions and requests from Architect and the USGBC regarding LEED credits that are the responsibility of the Contractor, that depend on product selection or product qualities, or that depend on Contractor's procedures until the USGBC has made its determination on the project's LEED certification application. Document responses as informational submittals.

1.5 ACTION SUBMITTALS

- A. General: Submit additional LEED submittals required by other Specification Sections.
- B. LEED submittals are in addition to other submittals. If submitted item is identical to that submitted to comply with other requirements, submit duplicate copies as a separate submittal to verify compliance with indicated LEED requirements.
- C. LEED Documentation Submittals may include but are not limited to the following:
 - 1. Prerequisite SS 1: Provide Construction Activity Pollution Prevention Plan in accordance to EPA-832-R Chapter 3.
 - 2. Credit SS 7.1: Product data for impervious hardscapes indicating compliance with solar Reflectance Index requirements.
 - 3. Credit SS 7.2: Product data for roofing materials indicating compliance with solar Reflectance Index requirements.
 - 4. Credit SS 8: Product Data for interior and exterior lighting fixtures that stop direct-beam illumination from leaving the building site.
 - 5. Credit WE 3: Product data or certification letters for all plumbing fixtures documenting flow rates and/or flush volumes.

6. Credit EA 4: Product data for new HVAC equipment indicating absence of HCFC refrigerants and for clean-agent fire-extinguishing systems indicating absence of HCFC and Halon.
7. Credit EA 5: Product data and wiring diagrams for sensors and data collection system used to provide continuous metering of building energy-consumption performance over a period of time of not less than two years of post-construction occupancy.
8. Credit MR 2: Comply with Division 01 Section "Construction Waste Management and Disposal."
9. Credit MR 4: Product data or certification letters indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content. Include statement indicating cost for each product having recycled content.
10. Credit MR 5: Product data or certification letters for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
11. Credit MR 7: Product data and chain-of-custody certificates for products containing certified wood. Include statement indicating cost for each certified wood product.
12. Prerequisite IEQ 2: Signed statement describing the exterior locations for smoking, and the action plan for the prohibition of smoking within the structure footprint during construction.
13. Credit IEQ 1: Product Data and Shop Drawings for carbon dioxide monitoring system.
14. Credit IEQ 3.1:
 - a. Construction indoor-air-quality management plan.
 - b. Product data for temporary filtration media.
 - c. Product data for filtration media used during occupancy.
 - d. Construction Documentation: Six photographs at three different times during the construction period, along with a brief description of the SMACNA approach employed, documenting implementation of the indoor-air-quality management measures, such as protection of ducts and on-site stored or installed absorptive materials.
15. Credit IEQ 3.2:
 - a. Signed statement describing the building air flush-out procedures including the dates when flush-out was begun and completed and statement that filtration media was replaced after flush-out.
 - b. Product data for filtration media used during flush-out and during occupancy.
 - c. Report from testing and inspecting agency indicating results of indoor-air-quality testing and documentation showing compliance with indoor-air-quality testing procedures and requirements.
16. Credit IEQ 4.1: Product data for adhesives and sealants used inside the weatherproofing system indicating VOC content of each product used. Indicate VOC content in g/L calculated according to 40 CFR 59 Subpart D (EPA Method 24)
17. Credit IEQ 4.2: Product data for paints and coatings used inside the weatherproofing system indicating VOC content of each product used. Indicate VOC content in g/L calculated according to 40 CFR 59 Subpart D (EPA Method 24)
18. Credit IEQ 4.3: Product data for coloring systems used inside the weatherproofing system indicating VOC content of each product used.
19. Credit IEQ 4.4: Product data or certification letter for all composite wood and/or agrifiber products, and adhesives to verify that they do not
20. Credit ID 1: Provide copy of Cradle to Cradle Product Certificate issued by MBDC for all products which have product certification.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For LEED coordinator.
- B. Project Materials Cost Data: Provide statement indicating total cost for materials used for Project. Costs exclude labor, overhead, and profit. Include breakout of costs for the following categories of items:
 - 1. Furniture.
 - 2. Plumbing.
 - 3. Mechanical.
 - 4. Electrical.
 - 5. Specialty items such as elevators and equipment.
 - 6. Wood-based construction materials.
- C. LEED Action Plans: Provide preliminary submittals within seven days of date established for the Notice to Proceed indicating how the following requirements will be met:
 - 1. Credit MR 2: Waste management plan complying with Division 01 Section "Construction Waste Management and Disposal."
 - 2. Credit MR 4: List of proposed materials with recycled content. Indicate cost, post-consumer recycled content, and pre-consumer recycled content for each product having recycled content.
 - 3. Credit MR 5: List of proposed regional materials. Identify each regional material, including its source, cost, and the fraction by weight that is considered regional.
 - a. Include statement indicating distance from manufacturer/ extraction point to Project for each regionally manufactured material.
 - 4. Credit MR 7: List of proposed certified wood products. Indicate each product containing certified wood, including its source and cost of certified wood products.
 - 5. Credit IEQ 3.1: Construction indoor-air-quality management plan.
- D. LEED Progress Reports: Concurrent with each Application for Payment, submit reports comparing actual construction and purchasing activities with LEED action plans for the following:
 - 1. Credit MR 2: Waste reduction progress reports complying with Division 01 Section "Construction Waste Management and Disposal."
 - 2. Credit MR 4: Recycled content.
 - 3. Credit MR 5: Regional materials.
 - 4. Credit MR 7: Certified wood products.

1.7 QUALITY ASSURANCE

- A. LEED Coordinator: Engage a field experienced LEED-Accredited Professional to coordinate LEED requirements on site under supervision of General Contractor. LEED coordinator may also serve as waste management coordinator.
 - 1. Submit copy of LEED Professional Accreditation Certificate issued by Green Building Certification Institute for LEED coordinator.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Provide products and procedures necessary to obtain LEED credits required in this Section. Although other Sections may specify some requirements that contribute to LEED credits, the Contractor shall determine additional materials and procedures necessary to obtain LEED credits indicated.

2.2 RECYCLED CONTENT OF MATERIALS

- A. Credit MR 4: Building materials shall have recycled content such that post-consumer recycled content plus one-half of pre-consumer recycled content for Project constitutes a minimum of 20 percent of cost of materials used for Project.
 - 1. Cost of post-consumer recycled content plus one-half of pre-consumer recycled content of an item shall be determined by dividing weight of post-consumer recycled content plus one-half of pre-consumer recycled content in the item by total weight of the item and multiplying by cost of the item.
 - 2. Do not include furniture, plumbing, mechanical and electrical components, and specialty items such as elevators and equipment in the calculation.
 - 3. Provide copy of Cradle to Cradle Product Certificate issued by MBDC if applicable.

2.3 REGIONAL MATERIALS

- A. Credit MR 5: Not less than 20 percent of building materials (by cost) shall be regional materials.

2.4 CERTIFIED WOOD

- A. Credit MR 7: Not less than 50 percent (by cost) of wood-based materials shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
 - 1. Wood-based materials include, but are not limited to, the following materials when made from wood, engineered wood products, or wood-based panel products:
 - a. Rough carpentry.
 - b. Miscellaneous carpentry.
 - c. Heavy timber construction.
 - d. Wood decking.
 - e. Metal-plate-connected wood trusses.
 - f. Structural glued-laminated timber.
 - g. Finish carpentry.
 - h. Architectural woodwork.
 - i. Wood paneling.
 - j. Wood veneer wall covering.
 - k. Wood flooring.
 - l. Wood lockers.
 - m. Wood cabinets.
 - n. Furniture.

2.5 LOW-EMITTING MATERIALS

- A. Credit IEQ 4.1: For field applications that are inside the weatherproofing system, adhesives and sealants shall comply with the following VOC content limits when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
1. Wood Glues: 30 g/L.
 2. Metal-to-Metal Adhesives: 30 g/L.
 3. Adhesives for Porous Materials (Except Wood): 50 g/L.
 4. Subfloor Adhesives: 50 g/L.
 5. Plastic Foam Adhesives: 50 g/L.
 6. Carpet Adhesives: 50 g/L.
 7. Carpet Pad Adhesives: 50 g/L.
 8. VCT and Asphalt Tile Adhesives: 50 g/L.
 9. Cove Base Adhesives: 50 g/L.
 10. Gypsum Board and Panel Adhesives: 50 g/L.
 11. Rubber Floor Adhesives: 60 g/L.
 12. Ceramic Tile Adhesives: 65 g/L.
 13. Multipurpose Construction Adhesives: 70 g/L.
 14. Fiberglass Adhesives: 80 g/L.
 15. Contact Adhesive: 80 g/L.
 16. Structural Glazing Adhesives: 100 g/L.
 17. Wood Flooring Adhesive: 100 g/L.
 18. Structural Wood Member Adhesive: 140 g/L.
 19. Single-Ply Roof Membrane Adhesive: 250 g/L.
 20. Special-Purpose Contact Adhesive (contact adhesive that is used to bond melamine-covered board, metal, unsupported vinyl, rubber, or wood veneer 1/16 inch or less in thickness to any surface): 250 g/L.
 21. Top and Trim Adhesive: 250 g/L.
 22. Plastic Cement Welding Compounds: 250 g/L.
 23. ABS Welding Compounds: 325 g/L.
 24. CPVC Welding Compounds: 490 g/L.
 25. PVC Welding Compounds: 510 g/L.
 26. Adhesive Primer for Plastic: 550 g/L.
 27. Sheet-Applied Rubber Lining Adhesive: 850 g/L.
 28. Aerosol Adhesive, General-Purpose Mist Spray: 65 percent by weight.
 29. Aerosol Adhesive, General-Purpose Web Spray: 55 percent by weight.
 30. Special-Purpose Aerosol Adhesive (All Types): 70 percent by weight.
 31. Other Adhesives: 250 g/L.
 32. Architectural Sealants: 250 g/L.
 33. Non-membrane Roof Sealants: 300 g/L.
 34. Single-Ply Roof Membrane Sealants: 450 g/L.
 35. Other Sealants: 420 g/L.
 36. Sealant Primers for Nonporous Substrates: 250 g/L.
 37. Sealant Primers for Porous Substrates: 775 g/L.
 38. Modified Bituminous Sealant Primers: 500 g/L.
 39. Other Sealant Primers: 750 g/L.
- B. Credit IEQ 4.2: For field applications that are inside the weatherproofing system, paints and coatings shall comply with the following VOC content limits when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
1. Flat Paints and Coatings: VOC not more than 50 g/L.
 2. Non-flat Paints and Coatings: VOC not more than 150 g/L.
 3. Dry-Fog Coatings: VOC not more than 400 g/L.
 4. Primers, Sealers, and Undercoaters: VOC not more than 200 g/L.
 5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
 6. Zinc-Rich Industrial Maintenance Primers: VOC not more than 340 g/L.

7. Pretreatment Wash Primers: VOC not more than 420 g/L.
 8. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.
 9. Clear Wood Finishes, Lacquers: VOC not more than 550 g/L.
 10. Floor Coatings: VOC not more than 100 g/L.
 11. Shellacs, Clear: VOC not more than 730 g/L.
 12. Shellacs, Pigmented: VOC not more than 550 g/L.
 13. Stains: VOC not more than 250 g/L.
- C. Credit IEQ 4.4: Composite wood, agrifiber products, and adhesives shall not contain urea-formaldehyde resin.

PART 3 - EXECUTION

3.1 REFRIGERANT AND CLEAN-AGENT FIRE-EXTINGUISHING-AGENT REMOVAL

- A. Prerequisite EA 3: Remove CFC-based refrigerants from existing HVAC&R equipment indicated to remain and replace with refrigerants that are not CFC based. Replace or adjust existing equipment to accommodate new refrigerant as described in Division 23 Sections.
- B. Credit EA 4: Remove clean-agent fire-extinguishing agents that contain HCFCs or Halons and replace with agent that does not contain HCFCs or Halons. See Division 21 Section "Clean-Agent Fire-Extinguishing Systems" for additional requirements.

3.2 CONSTRUCTION WASTE MANAGEMENT

- A. Credit MR 2: Comply with Division 01 Section "Construction Waste Management and Disposal."

3.3 CONSTRUCTION INDOOR-AIR-QUALITY MANAGEMENT

- A. Credit IEQ 3.1: Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."
1. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Division 01 Section "Temporary Facilities and Controls," install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
 2. Replace all air filters immediately prior to occupancy.
- B. Credit IEQ 3.2: The Owner has contracted with a 3rd party testing agency to provide air quality testing to comply with IEQ 3.2. The Contractor shall assist in the scheduling and coordination of the testing. If the testing fails due to high concentrations or other factors, the Contractor shall assist the testing agency in supplemental flush-out. If the concentration levels remain too high, the Contractor shall comply with the flush-out procedures detailed as follows:
1. After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total volume of 14000 cu. ft. (4 300 000 L) of outdoor air per sq. ft. (sq. m) of floor area while maintaining an internal temperature of at least 60 deg F (16 deg C) and a relative humidity no higher than 60 percent.

2. If occupancy is desired prior to flush-out completion, the space may be occupied following delivery of a minimum of 3500 cu. ft. (1 070 000 L) of outdoor air per sq. ft. (sq. m) of floor area to the space. Once a space is occupied, it shall be ventilated at a minimum rate of 0.30 cfm per sq. ft. (1.52 L/s per sq. m) of outside air or the design minimum outside air rate determined in Prerequisite EQ 1, whichever is greater. During each day of the flush-out period, ventilation shall begin a minimum of three hours prior to occupancy and continue during occupancy. These conditions shall be maintained until a total of 14000 cu. ft./sq. ft. (4 300 000 L/sq. m) of outside air has been delivered to the space.
3. Air-Quality Testing:
 - a. Conduct baseline indoor-air-quality testing, after construction ends and prior to occupancy, using testing protocols consistent with the EPA's "Compendium of Methods for the Determination of Air Pollutants in Indoor Air," and as additionally detailed in the USGBC's "Green Building Design and Construction Reference Guide."
 - b. Demonstrate that the contaminant maximum concentrations listed below are not exceeded:
 - 1) Formaldehyde: 27 ppb.
 - 2) Particulates (PM10): 50 micrograms/cu. m.
 - 3) Total Volatile Organic Compounds (TVOC): 500 micrograms/cu. m.
 - 4) 4-Phenylcyclohexene (4-PH): 6.5 micrograms/cu. m.
 - 5) Carbon Monoxide: 9 ppm and no greater than 2 ppm above outdoor levels.
 - c. For each sampling point where the maximum concentration limits are exceeded, conduct additional flush-out with outside air and retest the specific parameter(s) exceeded to indicate the requirements are achieved. Repeat procedure until all requirements have been met. When retesting noncomplying building areas, take samples from same locations as in the first test.
 - d. Air-sample testing shall be conducted as follows:
 - 1) All measurements shall be conducted prior to occupancy but during normal occupied hours, and with building ventilation system starting at the normal daily start time and operated at the minimum outside air flow rate for the occupied mode throughout the duration of the air testing.
 - 2) Building shall have all interior finishes installed including, but not limited to, millwork, doors, paint, carpet, and acoustic tiles. Nonfixed furnishings such as workstations and partitions are encouraged, but not required, to be in place for the testing.
 - 3) Number of sampling locations varies depending on the size of building and number of ventilation systems. For each portion of building served by a separate ventilation system, the number of sampling points shall not be less than one per 25,000 sq. ft. (2300 sq. m) or for each contiguous floor area, whichever is larger, and shall include areas with the least ventilation and greatest presumed source strength.
 - 4) Air samples shall be collected between 3 and 6 feet (0.9 and 1.8 m) from the floor to represent the breathing zone of occupants, and over a minimum four-hour period.

3.4 ATTACHMENTS

- A. Form LEED 2009 for New Construction and Major Renovation Project Scorecard

END OF SECTION 01 8113.13

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.2 SUBMITTALS

- A. Product Data: For each type of manufactured material and product indicated.
- B. Design Mixes: For each concrete mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mix water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Details of fabrication, bending, and placement, prepared according to ACI 315, "Details and Detailing of Concrete Reinforcement." Include material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement, and supports of concrete reinforcement. Include special reinforcement required for openings through concrete structures.
- D. Welding Certificates: Copies of certificates for welding procedures and personnel.
- E. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:
- F. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:
 - 1. Cementitious materials and aggregates.
 - 2. Form materials and form-release agents.
 - 3. Steel reinforcement and reinforcement accessories.
 - 4. Admixtures.
 - 5. Waterstops.
 - 6. Curing materials.
 - 7. Floor and slab treatments.
 - 8. Bonding agents.
 - 9. Adhesives.
 - 10. Vapor retarders.
 - 11. Epoxy joint filler.
 - 12. Joint-filler strips.
 - 13. Repair materials.
- G. LEED Submittals
 - 1. Recycled Content- Credit MR 4.2: Provide documentation indicating percentages of post-consumer and pre-consumer recycled content by weight per unit of product or assembly containing the product. Indicate the percentage of the dollar

value of the recycled content compared to the total dollar value of the product or assembly containing the product.

2. Regional Material- Credit MR 5.2: Where the distance to the project site is 500 miles or less, indicate location and distance to project site of extraction, harvesting, recovery and manufacturing of all materials. Indicate the dollar value of the material cost of the product containing local/regional materials. Where product components are sourced or manufactured in separate locations, provide location and percentage by weight of each component per unit of product.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed concrete Work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
- C. Testing Agency Qualifications: An independent testing agency shall be retained by the Owner, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.
 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.
- E. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code-Reinforcing Steel."
- F. ACI Publications: Comply with the following, unless more stringent provisions are indicated:
 1. ACI 301, "Specification for Structural Concrete."
 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- H. Preinstallation Conference: Conduct conference at Project site.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 1. Plywood, metal, or other approved panel materials.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- D. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- E. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of the exposed concrete surface.
 - 2. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.
- C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice."

2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type I/II.
 - a. Fly Ash: ASTM C 618, Class C or F.
- B. Normal-Weight Aggregates: ASTM C 33, Grading Size No. 57 or No. 67, graded, 3/4-inch nominal maximum coarse-aggregate size.
- C. Water: ASTM C 94/C 94M and potable.
- D. Air-Entraining Admixture: ASTM C 260.
- E. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.4 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
- F. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound:
 - a. Klear-Kote Cure-Sealer-Hardener, 30 percent solids; Burke Group, LLC (The).
 - b. Polyseal WB; ChemMasters.
 - c. UV Safe Seal; Lambert Corporation.

2.5 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Epoxy Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Shore A hardness of 80 per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy-Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements, and as follows:
 - 1. Type II, non-load bearing, for bonding freshly mixed concrete to hardened concrete.
 - 2. Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
 - 3. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.6 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.

3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.
- B. Repair Topping: Traffic-bearing, cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch.
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 5700 psi at 28 days when tested according to ASTM C 109/C 109M.

2.7 CONCRETE MIXTURES

- A. Prepare design mixes for each type and strength of concrete determined by either laboratory trial mix or field test data bases, as follows:
1. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.
- B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the laboratory trial mix basis.
- C. Footings and Foundation Walls: Proportion normal-weight concrete mix as follows:
1. Compressive Strength (28 Days): 3000 psi.
 2. Maximum Slump: 4 inches.
 3. Air Entrained (Exterior Wall Locations): 6% (+/- 1%).
- D. Interior Slab-on-Grade: Proportion normal-weight concrete mix as follows:
1. Compressive Strength (28 Days): 3000 psi.
 2. Minimum Cementitious Materials Content: 517 lb/cu. yd..
 3. Maximum Slump: 4 inches.
- E. Exterior Slab-on-Grade: Proportion normal-weight concrete mix as follows:
1. Compressive Strength (28 Days): 4500 psi (31.0 MPa).
 2. Minimum Cementitious Materials Content: 564 lb/cu. Yd. (309 kg/cu.m).
 3. Maximum Slump: 4 inches (100mm).
 4. Air Entrained: 6% (+/- 1%).
- F. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
1. Fly Ash: For lightweight concrete mix only, 25 percent or 100 lbs. maximum per cu. yd.
- G. Maximum Water-Cementitious Materials Ratio: 0.50 for concrete required to have low water permeability.
- H. Maximum Water-Cementitious Materials Ratio: 0.45 for concrete exposed to deicers or subject to freezing and thawing while moist.

- I. Maximum Water-Cementitious Materials Ratio: 0.40 for corrosion protection of steel reinforcement in concrete exposed to chlorides from deicing chemicals, salt, saltwater, brackish water, seawater, or spray from these sources.
- J. Do not air entrain concrete to trowel-finished interior floors. Do not allow entrapped air content to exceed 3 percent.
- K. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- L. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete, as required, for placement and workability.
 - 2. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

2.8 FABRICATING REINFORCEMENT

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

2.9 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F, 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

- 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 347R as abrupt or gradual, as follows:
 - 1. Class A, 1/8 inch.
 - 2. Class B, 1/4 inch.
 - 3. Class C, 1/2 inch.
 - 4. Class D, 1 inch.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide

top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.

1. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
1. Install anchor bolts and other embedded items, accurately located, to elevations required.

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork, for sides of beams, walls, columns, and similar parts of the Work, that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete provided concrete is hard enough to not be damaged by form-removal operations and provided curing and protection operations are maintained.
- B. Leave formwork, for beam soffits, joists, slabs, and other structural elements, that supports weight of concrete in place until concrete has achieved the following:
1. 28-day design compressive strength.
- C. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

- D. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials.
- 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.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire fabric in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.5 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 Architect.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form from preformed galvanized steel, plastic keyway-section forms, or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
 - 3. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 4. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 - 5. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 6. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness, as follows:
 - 1. Grooved Joints at Exterior Slabs: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 - 2. Sawed Joints at Interior Slabs: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8 inch (3 mm) wide joints into

concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
 - 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 7 Section "Joint Sealants," are indicated.
 - 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Expansion Joints: Install dowel sleeves and dowels or dowel bar and support assemblies at joints where indicated.
 - 1. Use dowel sleeves or 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 have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement, unless approved by Architect.
- C. Before placing concrete, water may be added at Project site, subject to limitations of ACI 301.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
- E. Deposit concrete in forms in horizontal layers no deeper than 24 inches and in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic, to avoid cold joints.
 - 1. Consolidate placed concrete with mechanical vibrating equipment. Use equipment and procedures for consolidating concrete recommended by ACI 309R.
 - 2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the vibrator. Place vibrators 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 mix constituents to segregate.
- F. 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, free of humps or hollows, before excess moisture or bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- G. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
 2. Do not use frozen materials or materials containing ice or snow. 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 mix designs.
- H. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows, when hot-weather conditions exist:
1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections exceeding ACI 347R limits for class of surface specified.
- B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.8 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
1. Apply float finish to surfaces to be covered with sand-bed terrazzo.

- C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighthen until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
1. Apply a trowel finish to surfaces indicated and to floor and slab surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin film-finish coating system
 2. Finish surfaces to the following tolerances, measured within 24 hours according to ASTM E 1155/E 1155M for a randomly trafficked floor surface:
 - a. Specified overall values of flatness, F(F) 35; and levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and levelness, F(L) 17; for slabs-on-grade.
- D. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

3.9 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete Work.
- B. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.

3.10 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. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing by one or a combination of the following methods:
- C. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces, by one or a combination of the following methods:
1. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer recommends for use with floor coverings.
 2. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written

instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.11 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
 - 1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
 - 2. Do not apply to concrete that is less than seven days old.
 - 3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.
- B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.12 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 six months. 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 joint clean and dry.

3.13 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match

- before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to 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 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 mix 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 Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.
- 3.14 FIELD QUALITY CONTROL
- A. Testing and Inspecting: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections on concrete and reinforcing and prepare test reports.
 - B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mix exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.

2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mix placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mix, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 3. 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 mix. Perform additional tests when concrete consistency appears to change.
 4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
 5. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
 6. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of four standard cylinder specimens for each composite sample.
 - a. Cast and field cure one set of four standard cylinder specimens for each composite sample.
 7. Compressive-Strength Tests: ASTM C 39; test two laboratory-cured specimens at 7 days and two at 28 days.
 - a. Test two field-cured specimens at 7 days and two at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at age indicated.
- C. 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.
- D. Strength of each concrete mix 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.
- E. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-and 28-day tests.
- F. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- G. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Architect.

END OF SECTION 033000

SECTION 05 5000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Steel framing and supports for operable partitions.
2. Steel framing and supports for overhead doors.
3. Steel framing and supports for countertops.
4. Steel framing and supports for mechanical and electrical equipment.
5. Steel framing and supports for applications where framing and supports are not specified in other Sections.
6. Metal bollards and plastic sleeves.
7. Loose bearing and leveling plates for applications where they are not specified in other Sections.
8. Steel access ladders

- B. Related Sections:

1. Division 03 Section "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
2. Division 13 Section "Metal Building Systems."

1.3 PERFORMANCE REQUIREMENTS

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

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

1.4 ACTION SUBMITTALS

- A. LEED Submittals:

1. Recycled Content – Credit MR 4.2: Provide documentation indicating percentages of post-consumer and pre-consumer recycled content by weight per unit of product or assembly containing the product. Indicate the percentage of the dollar of the recycled content compared to the total dollar value of the product or assembly containing the product.

- B. Shop Drawings: Show fabrication and installation details for metal fabrications.
 - 1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified professional engineer.
- B. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - 3. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.7 PROJECT CONDITIONS

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

1.8 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

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

2.2 FERROUS METALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 304.
- D. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.
- E. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40) unless otherwise indicated.

2.3 NONFERROUS METALS

- A. Aluminum Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.
- B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.
- C. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

2.4 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 aluminum.
 - 2. 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. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593 (ASTM F 738M); with hex nuts, ASTM F 594 (ASTM F 836M); and, where indicated, flat washers; Alloy Group 2 (A4).
- D. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
 - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- E. Eyebolts: ASTM A 489.
- F. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).
- G. Lag Screws: ASME B18.2.1 (ASME B18.2.3.8M).
- H. Wood Screws: Flat head, ASME B18.6.1.
- I. Plain Washers: Round, ASME B18.22.1 (ASME B18.22M).
- J. Lock Washers: Helical, spring type, ASME B18.21.1 (ASME B18.21.2M).

- K. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- L. 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.
- M. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 2 (A4) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Shop Primers: Provide primers that comply with Division 09 painting Sections.
- C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- 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.
- F. Nonshrink, Metallic Grout: Factory-packaged, ferrous-aggregate grout complying with ASTM C 1107, specifically recommended by manufacturer for heavy-duty loading applications.
- G. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- H. Concrete: Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa).

2.6 FABRICATION, GENERAL

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

- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing 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 will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
 - 1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

2.7 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
 - 1. Furnish inserts for units installed after concrete is placed.
- C. Fabricate supports for operable partitions from continuous steel beams of sizes indicated with attached bearing plates, anchors, and braces as recommended by partition manufacturer. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.

- D. Galvanize miscellaneous framing and supports where indicated.

2.8 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. Galvanize exterior miscellaneous steel trim.

2.9 METAL BOLLARDS

- A. Fabricate metal bollards from Schedule 80 steel pipe.
- B. Prime bollards with zinc-rich primer.
- C. Provide tight fitting vertical ribbed plastic bollard sleeve for bollards at overhead doors.

2.10 METAL LADDERS

- A. General:
 - 1. Comply with ANSI A14.3, unless otherwise indicated.
 - 2. Space siderails 18 inches (457 mm) apart, unless otherwise indicated.
 - 3. Support each ladder at top and bottom, and not more than 60 inches o.c. with welded or bolted brackets, made from same metal as ladder.
- B. Steel Ladders (mechanical mezzanine):
 - 1. Siderails: Continuous, 3/8-by-2-1/2-inch (9.5-by-64-mm) steel flat bars, with eased edges.
 - 2. Rungs: 3/4-inch- (19-mm-) diameter steel bars.
 - 3. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
 - 4. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
 - 5. Products:
 - a. IKG Industries, a Harsco company; Mebac.
 - b. W. S. Molnar Company; SlipNOT.
 - 6. Prime interior ladders, where indicated, including brackets and fasteners, with zinc-rich primer.

2.11 LOOSE BEARING AND LEVELING PLATES

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

2.12 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.

2.13 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.
- C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.14 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
 - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
- C. 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. Other Items: SSPC-SP 3, "Power Tool Cleaning."
- D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.15 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
 - 1. Cast Aluminum: Heavy coat of bituminous paint.
 - 2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor supports for operable partitions securely to and rigidly brace from building structure.

3.3 INSTALLING METAL BOLLARDS

- A. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches (75 mm) above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.
- B. Fill bollards solidly with concrete, mounding top surface to shed water.
- C. Provide tight fitting vertical ribbed plastic bollard sleeve for bollards at overhead doors.
- D. Interior bollards at perimeter guardrail shall be anchored to the concrete slab with 3/4" x 6" epoxy anchors.

3.4 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
 - 1. Use nonshrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations unless otherwise indicated.
 - 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.5 INSTALLING LADDERS

- A. Fastening to In-Place Construction: provide anchorage devices and fasteners where necessary for securing steel stairs to in-place construction; include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors as required.
- B. Cutting, Fitting and Placement: Perform cutting, drilling and fitting required for installing steel stairs. Set units accurately in location, alignment and elevation; with edges and surfaces level, plumb, true and free of rack; and measured from established lines and levels.
- C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete masonry or similar construction.
- D. 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 the surface or exterior units which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.

3.6 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05 5000

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - A. Rooftop equipment bases and support curbs.
 - B. Wood blocking, cants, and nailers.
 - C. Wood furring and grounds.
 - D. Plywood backing panels.
- B. Related Requirements:

1.3 DEFINITIONS

- A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.
- B. Lumber grading agencies, and the abbreviations used to reference them, include the following:
 - A. NeLMA: Northeastern Lumber Manufacturers' Association.
 - B. NLGA: National Lumber Grades Authority.
 - C. SPIB: The Southern Pine Inspection Bureau.
 - D. WCLIB: West Coast Lumber Inspection Bureau.
 - E. WWPA: Western Wood Products Association.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - A. 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.
 - B. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
 - C. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 - D. Include copies of warranties from chemical treatment manufacturers for each type of treatment.
- B. Fastener Patterns: Full-size templates for fasteners in exposed framing.

1.5 LEED SUBMITTALS

- A. Certificates for Credit MR 7: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification requirements. Include documentation that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.
- B. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.

1.6 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
- B. Evaluation Reports: For the following, from ICC-ES:
 - A. Fire-retardant-treated wood.
 - B. Power-driven fasteners.
 - C. Powder-actuated fasteners.
 - D. Expansion anchors.
 - E. Metal framing anchors.

1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Certified Wood: All wood materials shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
 - A. Miscellaneous lumber.
- B. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

- A. Factory mark each piece of lumber with grade stamp of grading agency.
- B. 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.
- C. Provide dressed lumber, S4S, unless otherwise indicated.

C. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

2.2 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
 - A. Use treatment that does not promote corrosion of metal fasteners.
 - B. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
- C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
- E. Application: Treat all rough carpentry unless otherwise indicated.

2.3 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - A. Blocking.
 - B. Nailers.
 - C. Rooftop equipment bases and support curbs.
 - D. Cants.
 - E. Furring.
 - F. Grounds.
 - G. Utility shelving.
- B. For items of dimension lumber size, provide Construction or No. 2 grade lumber of any species.
 - A. Hem-fir (north); NLGA.
 - B. Mixed southern pine; SPIB.
 - C. Spruce-pine-fir; NLGA.
 - D. Hem-fir; WCLIB or WWPA.
 - E. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
- C. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

- 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.
- E. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.4 PLYWOOD BACKING PANELS

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

2.5 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - A. 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.
- F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 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 six times the load imposed when installed in unit masonry assemblies and equal to four 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.
 - A. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

2.6 METAL FRAMING ANCHORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - A. Cleveland Steel Specialty Co.
 - B. KC Metals Products, Inc.
 - C. Phoenix Metal Products, Inc.
 - D. Simpson Strong-Tie Co., Inc.
 - E. USP Structural Connectors.
 - F. Insert manufacturer's name.

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

2.7 MISCELLANEOUS MATERIALS

- A. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to suit width of sill members indicated.

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 furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- B. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.
- C. Metal Framing Anchors: Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- D. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.
- E. Do not splice structural members between supports unless otherwise indicated.
- F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
 - A. 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 o.c.
- G. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
 - A. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
 - B. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line

of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal- thickness.

- C. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.

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

- I. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

- A. NES NER-272 for power-driven fasteners.
- B. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.

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

3.2 WOOD GROUND, SLEEPER, BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for screeding or 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-preserved-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

3.3 PROTECTION

- A. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes sufficiently wet that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

SECTION 06 4023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:

1. Plastic-laminate cabinets.
2. Solid-surfacing-material countertops.
3. Solid-surfacing-material window sills.
4. Acrylic Panel & Standoffs
5. Decorative Interior Wall Surfacing System (Solid phenolic wall panels)
6. Display shelving.
7. Display case glass doors.

- B. Related Sections include the following:

1. Division 05 Section "Metal Fabrications" for steel counter supports.
2. Division 06 Section "Miscellaneous Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.
3. Division 09 Section "Non-Structural Metal Framing" for steel stud framing.
4. Division 09 Section "Fabric Wrapped Panels" to coordinate with Solid Phenolic wall panel installation.

1.3 DEFINITIONS

- A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, including cabinet hardware and accessories.
- B. Product Data: For panel products high-pressure decorative laminate adhesive for bonding plastic laminate solid-surfacing material cabinet hardware and accessories.
- C. LEED Submittals:
 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 2. Certificates for Credit MR 6 Credit MR 7: Chain-of-custody certificates indicating that interior architectural woodwork complies with forest certification requirements. Include documentation that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.

3. Product Data for Credit IEQ 4.1: For installation adhesives, documentation including printed statement of VOC content.
 4. Product Data for Credit IEQ 4.4: For composite wood products and adhesives, documentation indicating that product contains no urea formaldehyde.
- D. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
1. Show details full size.
 2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
 3. Show locations and sizes of cutouts and holes for plumbing fixtures faucets and other items installed in architectural woodwork.
- E. Samples for Verification:
1. Plastic laminates, 8 by 10 inches (200 by 250 mm), for each type, color, pattern, and surface finish.
 2. Thermoset decorative-panels, 8 by 10 inches (200 by 250 mm), for each type, color, pattern, and surface finish.
 3. Solid-surfacing materials, 6 inches (150 mm) square.
 4. Phenolic wall panel material, 6 inches (150 mm) square.
 5. Exposed cabinet hardware and accessories, one unit for each type.
 6. Acrylic panel material, 6 inches (150 mm) square.
- 1.5 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For Installer.
 - B. Product Certificates: For each type of product, signed by product manufacturer.
- 1.6 QUALITY ASSURANCE
- A. Manufacturers Qualifications
 1. Materials and systems shall be manufactured by a company continuously and regularly employed in the manufacture of specified materials for a period of at least five (5) consecutive years and which can show evidence of those materials being satisfactorily used on at least six (6) projects of similar size, scope and location. At least three (3) of the projects shall have been successful for use five (5) years or longer.
 2. Manufactured panels must be produced from a minimum of 40% post-industrial recycle content. This recycle content must be certified by a recognized 3rd party certification group, such as Scientific Certification Systems (SCS).
 3. Manufacturer must offer a documented reclaim process that will take back, at the manufacturer's cost, panels that are at their end-of life cycle. Return process is preceded by following requirements highlighted in Section 02 42 00 Removal and Salvage of Construction Materials.
 - B. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of interior architectural woodwork, solid surface counters and sills, and other fabrications of millwork as a whole. Multiple trades will not be accepted.
 - C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.8 Deliver Plastic Fabrications, systems and specified items in manufacturer's standard protective packaging.

- A. Do not deliver Plastic Fabrications, system, components and accessories to Project site until areas are ready for installation.
- B. Store materials in a flat orientation in a dry place that is not exposed to exterior elements.
- C. Store products in manufacturer's unopened packaging until ready for installation.
- D. Stack panels using protective dividers to avoid damage to decorative surface.
- E. For horizontal storage, store sheets on pallets of equal or greater size as the sheets with a protective layer between the pallet and sheet and on top of the uppermost sheet. Do not store sheets, or fabricated panels vertically.
- F. Handle materials to prevent damage to finished surfaces. Provide protective coverings to prevent damage or staining following installation for duration of project.
- G. Before installing Plastic Fabrications, permit them to reach room temperature.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 25 and 55 percent during the remainder of the construction period.
- C. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
 - 2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.10 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.
- B. Hardware Coordination: Distribute copies of approved hardware schedule specified in Division 08 Section "Door Hardware (Scheduled by Describing Products)" to fabricator of architectural woodwork; coordinate Shop Drawings and fabrication with hardware requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.
- B. Certified Wood: Interior architectural woodwork shall be produced from wood obtained from forests certified by an FSC accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
- C. Wood Products: Comply with the following:
 - 1. Recycled Content of Medium-Density Fiberboard and Particleboard: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 100 percent.
 - 2. Hardboard: AHA A135.4.
 - 3. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.
 - 4. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde.
 - 5. Particleboard: Straw-based particleboard complying with requirements in ANSI A208.1, Grade M-2, except for density.
 - 6. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1, made with adhesive containing no urea formaldehyde.
- D. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.
 - 1. Provide PVC or polyester edge banding complying with LMA EDG-1 on components with exposed or semi exposed edges.
- E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.
 - 1. Manufacturer: Subject to compliance with requirements, provide high-pressure decorative laminates by one of the following:
 - a. Formica Corporation.
 - b. Lamin-Art, Inc.
 - c. Pionite
 - d. Wilsonart International
- F. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ISSFA-2.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Du Pont, Corian, Grades A, B, or C.
 - b. LG Chemical, Ltd., Classics
 - c. Samsung; Cheil Industries Inc.
 - d. Wilsonart International; Div. of Premark International, Inc.
2. Type: Standard type, unless Special Purpose type is indicated.
 3. Colors and Patterns: As selected by Architect. Up to 4 colors may be used.

2.2 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 08 Section "Door Hardware (Scheduled by Describing Products)."
- B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 170 degrees of opening.
- C. Back-Mounted Pulls: BHMA A156.9, B02011.
 1. Basis of Design: Hafele 124.02.920 Drawer Pulls
- D. Wire Pulls: Back mounted, solid.
 1. Basis of Design: Hafele 115.20.002 Door Pulls
- E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04102; with shelf brackets, B04112.
- F. Shelf Rests: BHMA A156.9, B04013; metal, two-pin type with shelf hold-down clip.
- G. Drawer Slides: BHMA A156.9, B05091.
 1. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; full-extension type; zinc-plated steel ball-bearing slides.
 2. Box Drawer Slides: Grade 1HD-100; for drawers not more than 6 inches (150 mm) high and 24 inches (600 mm) wide.
 3. File Drawer Slides: Grade 1HD-100; for drawers more than 6 inches (150 mm) high or 24 inches (600 mm) wide.
 4. Pencil Drawer Slides: Grade 2; for drawers not more than 3 inches (75 mm) high and 24 inches (600 mm) wide.
- H. Grommets for Cable Passage through Countertops: molded-plastic grommets and matching plastic caps with slot for wire passage.
 1. Product: Subject to compliance with requirements, provide "RG series" by Doug Mockett & Company, Inc.
 2. Color selected by Architect from Manufacturer's full range.
- I. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. Satin Stainless Steel: BHMA 630.

J. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.3 STANDARDS AND BRACKETS

A. Shelf Standards and Brackets (at conference rooms):

1. Standards: Rakks C-Channel recessed
2. Bracket Type: Aria, two piece bracket for 12" deep glass shelf
3. Colors and Patterns: As selected by Architect from manufacturer's full range.

B. Horizontal Standards and Brackets (at Display Case):

1. Rail Type: Marlight Horizontal, Aluline
2. Bracket Type: Filigrano, glass shelf bracket 350mm-400mm depth
3. Colors and Patterns: As selected by Architect from manufacturer's full range.

2.4 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

C. Adhesives, General: Adhesives shall not contain urea formaldehyde.

D. VOC Limits for Installation Adhesives: Installation adhesives shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Wood Glues: 30 g/L.
2. Multipurpose Construction Adhesives: 70 g/L.
3. Contact Adhesive: 250 g/L.

E. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.

1. Adhesive for Bonding Edges: Hot-melt adhesive.

F. Materials for Acrylic / Resin Panel

1. Cleaner: Type recommended by manufacturer.
2. Fasteners: Use screws designed specifically for plastics. Self-threading screws are acceptable for permanent installations. Provide threaded metal inserts for applications requiring frequent disassembly such as light fixtures.
3. Drilled Panel Wall Anchors: As provided by the manufacturer. Provide extensions to accommodate thicknesses scheduled or illustrated.

2.5 FABRICATION, GENERAL

- A. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 - 1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
 - 2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.
- C. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
 - 1. Seal edges of openings in countertops with a coat of varnish.

2.6 PLASTIC-LAMINATE CABINETS

- A. AWI Type of Cabinet Construction: Flush overlay or As indicated.
- B. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
 - 1. Horizontal Surfaces Other Than Tops: Grade HGS.
 - 2. Postformed Surfaces: Grade HGP.
 - 3. Vertical Surfaces: Grade VGS.
 - 4. Edges: PVC edge banding, 0.12 inch (3 mm) thick, matching laminate in color, pattern, and finish].
- C. Materials for Semi exposed Surfaces:
 - 1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, Grade VGS.
 - a. Edges of Plastic-Laminate Shelves: PVC tape, 0.018-inch (0.460-mm) minimum thickness, matching laminate in color, pattern, and finish.
 - b. For semi exposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, Grade VGS.
 - 2. Drawer Sides and Backs: Solid-hardwood lumber.
 - 3. Drawer Bottoms: Hardwood plywood.
- D. Concealed Backs of Panels with Exposed Plastic Laminate Surfaces: High-pressure decorative laminate, Grade BKL.

- E. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - 1. As selected by Architect from laminate manufacturer's full range in the following categories:
 - a. Solid colors, matte finish.
 - b. Wood grains, matte finish.
 - c. Patterns, matte finish.
- F. Provide dust panels of 1/4-inch (6.4-mm) plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

2.7 SOLID-SURFACING-MATERIAL COUNTERTOPS

- A. Solid-Surfacing-Material Countertop Thickness: 1/2 inch (13 mm). Rounded Edge.
- B. Colors, Patterns, and Finishes: Provide materials and products that result in colors of solid-surfacing material complying with the following requirements:
 - 1. As selected by Architect from manufacturer's full range.
- C. Fabricate tops in one piece, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.
 - 1. Fabricate tops with shop-applied edges of materials and configuration indicated.
 - 2. Fabricate tops with loose backsplashes for field application.
- D. Drill holes in countertops for plumbing fittings and grommets in shop.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.
- B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.
- C. Before installing architectural woodwork for display cases, verify that internal framing and blocking is provided to adequately support weight of glass doors and to anchor top and bottom pivots.

3.2 INSTALLATION

- A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.
- B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.
- C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

- D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 - 1. Install cabinets with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
 - 2. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches (400 mm) o.c. with No. 10 wafer-head screws sized for 1-inch (25-mm) penetration into wood framing, blocking, or hanging strips No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.
 - 3. Provide 1/2" metal reveals, vertically and horizontally, at locations indicated on drawings.
 - 4. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.
- G. Countertops & Sills: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
 - 1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 - 2. Install countertops with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
 - 3. Secure backsplashes (where located) to tops with concealed metal brackets at 16 inches (400 mm) o.c. and to walls with adhesive.
 - 4. Calk space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealants."

3.3 ADJUSTING AND CLEANING

- A. Adjust final panel installation so that all joints are true and even throughout the installation. Panels out of plane shall be adjusted with the surrounding panels to minimize any imperfection.
- B. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- C. Clean, lubricate, and adjust hardware.
- D. Clean woodwork on exposed and semi exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.
- E. Clean all glass doors and shelves. Protect during and after installation against stains and damage during construction.

END OF SECTION 06 4023

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Extruded polystyrene foam-plastic board.
 - 2. Glass-fiber blanket.
- B. Related Requirements:
 - 1. Section 092216 Non Structural Metal Framing

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- B. Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.5 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 until just before installation time.
 - 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

- A. Extruded polystyrene boards in this article are also called "XPS boards." Roman numeral designators in ASTM C 578 are assigned in a fixed random sequence, and their numeric order does not reflect increasing strength or other characteristics.
- B. Extruded Polystyrene Board, Type VI : ASTM C 578, Type VI, 40-psi minimum compressive strength; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DiversiFoam Products.
 - b. Dow Chemical Company (The).
 - c. Owens Corning.

2.2 GLASS-FIBER BLANKET

- A. Sustainability Requirements: Provide glass-fiber blanket insulation as follows:
 - 1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
- B. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehydeGlass-Fiber Blanket, Unfaced : ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.
 - b. Guardian Building Products, Inc.
 - c. Johns Manville; a Berkshire Hathaway company.
 - d. Knauf Insulation.
 - e. Owens Corning.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

- C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF SLAB INSULATION

- A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.
 - 1. If not otherwise indicated, extend insulation a minimum of 24 inches below exterior grade line.

3.4 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 - 4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

3.5 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 072100

SECTION 072713 - MODIFIED BITUMINOUS SHEET AIR BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes self-adhering, vapor-retarding, modified bituminous sheet air barriers for connecting transitions between insulated metal wall panels and insulated metal roof panels, and between door frame, window frame and opening penetrations in wall and roof panels.

1.3 DEFINITIONS

- A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.
- B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.
- C. Air-Barrier Assembly: The collection of air-barrier materials and accessory materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of products.
- B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.2: For air-barrier primers, documentation including printed statement of VOC content.
- C. Shop Drawings: For air-barrier assemblies.
 - 1. Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
 - 2. Include details of interfaces with other materials that form part of air barrier.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

- B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with air barrier.
- C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- B. Protect stored materials from direct sunlight.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air-barrier manufacturer.
 - 1. Protect substrates from environmental conditions that affect air-barrier performance.
 - 2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. General: Air barrier shall be capable of performing as a continuous vapor-retarding air barrier. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
- B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested according to ASTM E 283.

2.3 SELF-ADHERING SHEET AIR BARRIER

- A. Modified Bituminous Sheet: 40-mil- thick, self-adhering sheet consisting of 36 mils of rubberized asphalt laminated to a 4-mil- thick, cross-laminated polyethylene film with release liner on adhesive side.
 - 1. Products: Subject to compliance with requirements, provide one of the following:

- a. Carlisle Coatings & Waterproofing Inc.; CCW-705.
- b. Grace, W. R. & Co. - Conn.; Perm-A-Barrier Wall Membrane.
- c. Henry Company; Blueskin SA.
- d. Meadows, W. R., Inc.; SealTight Air-Shield.
- e. Tremco Incorporated, an RPM company; ExoAir 110/110LT.

2. Physical and Performance Properties:

- a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.
- b. Tensile Strength: Minimum 250 psi; ASTM D 412, Die C.
- c. Ultimate Elongation: Minimum 200 percent; ASTM D 412, Die C.
- d. Puncture Resistance: Minimum 40 lbf; ASTM E 154.
- e. Water Absorption: Maximum 0.15 percent weight gain after 48-hour immersion at 70 deg F; ASTM D 570.

2.4 ACCESSORY MATERIALS

- A. General: Accessory materials recommended by air-barrier manufacturer to produce a complete air-barrier assembly and compatible with primary air-barrier membrane.
- B. Primer: Liquid waterborne primer recommended for substrate by air-barrier material manufacturer.
 1. VOC Content: 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and complying with VOC content limits of authorities having jurisdiction.
- C. Modified Bituminous Strip: Vapor retarding, 40 mils thick, smooth surfaced, self-adhering; consisting of 36 mils of rubberized asphalt laminated to a 4-mil- thick, cross-laminated polyethylene film with release liner backing.
- D. Termination Mastic: Air-barrier manufacturer's standard cold fluid-applied elastomeric liquid; trowel grade.
- E. Adhesive and Tape: Air-barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.
- F. Modified Bituminous Transition Strip: Vapor retarding, 40 mils thick, smooth surfaced, self-adhering; consisting of 36 mils of rubberized asphalt laminated to a 4-mil- thick polyethylene film with release liner backing.
- G. Elastomeric Flashing Sheet: ASTM D 2000, minimum 50- to 65-mil- thick, cured sheet neoprene with manufacturer-recommended contact adhesives and lap sealant with galvanized-steel termination bars and fasteners.
- H. Preformed Silicone-Sealant Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 123 Silicone Seal.
 - b. Momentive Performance Materials Inc.; US11000 UltraSpan.
 - c. Pecora Corporation; Sil-Span.
 - d. Tremco Incorporated, an RPM company; Spectrem Simple Seal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
 - 1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean, prepare, and treat substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air-barrier application.
- B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.
 - 1. Install modified bituminous strips and center over treated construction and contraction joints and cracks exceeding a width of 1/16 inch.
- E. Bridge and cover isolation joints expansion joints and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with overlapping modified bituminous strips.
- F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

3.3 INSTALLATION

- A. General: Install modified bituminous sheets and accessory materials according to air-barrier manufacturer's written instructions and according to recommendations in ASTM D 6135.
 - 1. When ambient and substrate temperatures range between 25 and 40 deg F, install self-adhering, modified bituminous air-barrier sheet produced for low-temperature application. Do not install low-temperature sheet if ambient or substrate temperature is higher than 60 deg F.
- B. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.
 - 1. Install modified bituminous strips centered over vertical inside corners. Install 3/4-inch fillets of termination mastic on horizontal inside corners.
- C. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations with termination mastic and according to ASTM D 6135.

- D. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier sheet on same day. Reprime areas exposed for more than 24 hours.
1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.
- E. Apply and firmly adhere modified bituminous sheets horizontally over area to receive air barrier. Accurately align sheets and maintain uniform 2-1/2-inch- minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure airtight installation.
1. Apply sheets in a shingled manner to shed water without interception by any exposed sheet edges.
 2. Roll sheets firmly to enhance adhesion to substrate.
- F. Apply continuous modified bituminous sheets over modified bituminous strips bridging substrate cracks, construction, and contraction joints.
- G. Seal exposed edges of sheet at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
- H. Install air-barrier sheet and accessory materials to form a seal with adjacent construction and to maintain a continuous air barrier.
1. Coordinate air-barrier installation with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
 2. Install modified bituminous strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.
- I. Connect and seal transition between insulated exterior wall panels and insulated roof panels continuously, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
- J. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply modified bituminous transition strip so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames with not less than 1 inch of full contact.
1. Modified Bituminous Transition Strip: Roll firmly to enhance adhesion.
 2. Elastomeric Flashing Sheet: Apply adhesive to wall, frame, and flashing sheet. Install flashing sheet and termination bars, fastened at 6 inches o.c. Apply lap sealant over exposed edges and on cavity side of flashing sheet.
 3. Preformed Silicone-Sealant Extrusion: Set in full bed of silicone sealant applied to walls, frame, and membrane.
- K. At end of each working day, seal top edge of air-barrier material to substrate with termination mastic.
- L. Repair punctures, voids, and deficient lapped seams in air barrier. Slit and flatten fishmouths and blisters. Patch with air-barrier sheet extending 6 inches beyond repaired areas in all directions.
- M. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.
- N. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements.
 - 1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
 - 2. Continuous structural support of air-barrier system has been provided.
 - 3. Site conditions for application temperature and dryness of substrates have been maintained.
 - 4. Maximum exposure time of materials to UV deterioration has not been exceeded.
 - 5. Surfaces have been primed.
 - 6. Laps in sheet materials have complied with the minimum requirements and have been shingled in the correct direction (or mastic applied on exposed edges), with no fishmouths.
 - 7. Termination mastic has been applied on cut edges.
 - 8. Air barrier has been firmly adhered to substrate.
 - 9. Compatible materials have been used.
 - 10. Transitions at changes in direction and structural support at gaps have been provided.
 - 11. Connections between assemblies (membrane and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
 - 12. All penetrations have been sealed.
- C. Tests: As determined by Owner's testing agency from among the following tests:
 - 1. Quantitative Air-Leakage Testing: Air-barrier assemblies will be tested for air leakage according to ASTM E 783.
- D. Air barriers will be considered defective if they do not pass tests and inspections.
 - 1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
 - 2. Remove and replace deficient air-barrier components for retesting as specified above.
- E. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

3.5 CLEANING AND PROTECTION

- A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
 - 1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. If exposed to these conditions for more than [30] <Insert number> days, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed membrane according to air-barrier manufacturer's written instructions.
 - 2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.
- B. Clean spills, stains, and soiling from construction that would be exposed in the completed Work, using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 072713

SECTION 07 6200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Formed Products:
 - a. Roof drainage fabrications.
 - b. Formed equipment support flashing.

B. Related Sections:

1. Division 06 Section "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.
2. Division 13 Section "Metal Building Systems"

1.2 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Fabricate and install roof edge flashing and copings capable of resisting the following forces according to recommendations in FMG Loss Prevention Data Sheet 1-49:

1. Wind Zone 2: For velocity pressures of 31 to 45 lbf/sq. ft. (1.48 to 2.15 kPa): 90-lbf/sq. ft. (4.31-kPa) perimeter uplift force, 120-lbf/sq. ft. (5.74-kPa) corner uplift force, and 45-lbf/sq. ft. (2.15-kPa) outward force.

C. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes.

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

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

B. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work. Include the following:

1. Identification of material, thickness, weight, and finish for each item and location in Project.
 2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
 3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
 4. Details of termination points and assemblies, including fixed points.
 5. Details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction.
 6. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
 7. Details of special conditions.
 8. Details of connections to adjoining work.
 9. Detail formed flashing and trim at a scale of not less than 1-1/2 inches per 12 inches (1:10).
- C. Samples for Initial Selection: For each type of sheet metal flashing, trim, and accessory indicated with factory-applied color finishes involving color selection.
- D. LEED Submittals:
1. Recycled Content – Credit MR 4.2: Provide documentation indicating percentages of post-consumer and pre-consumer recycled content by weight per unit or assembly containing the product. Indicate the percentage of the dollar value of the recycled content compared to the total dollar value of the product or assembly containing the product.
- 1.4 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For qualified fabricator.
 - B. Warranty: Sample of special warranty.
- 1.5 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For sheet metal flashing, trim, and accessories to include in maintenance manuals.
- 1.6 QUALITY ASSURANCE
- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
 - B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.
- 1.7 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.

1.8 WARRANTY

- A. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Final Completion.

PART 2 - PRODUCTS

2.1 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.
- B. Metallic-Coated Steel Sheet: Restricted flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - 1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation; structural quality.
 - 2. Surface: Smooth, flat.
 - 3. Exposed Coil-Coated Finish:
 - a. Mica Fluoropolymer: AAMA 621. Two-coat fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 4. Color: As selected by Architect from manufacturer's full range.
 - 5. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).
- C. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, dead soft, fully annealed.
 - 1. Finish: 4 (polished directional satin).
 - 2. Surface: Smooth, flat.

2.2 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
 - 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
 - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
 - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
 - 2. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329 or Series 300 stainless steel.
- C. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
- D. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane, polysulfide or silicone polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- F. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.
- G. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.3 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.
 - 1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 - 2. Obtain field measurements for accurate fit before shop fabrication.
 - 3. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.
- B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.
- C. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.
- D. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
- E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- F. Fabricate cleats and attachment devices of sizes as recommended by SMACNA's "Architectural Sheet Metal Manual" and by FMG Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.
- G. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
- H. Do not use graphite pencils to mark metal surfaces.

2.4 ROOF DRAINAGE SHEET METAL FABRICATIONS

- A. Hanging Gutters: Fabricate to cross section indicated, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch- (2400-mm-) long sections. Furnish flat-stock gutter spacers and gutter brackets fabricated from same metal as gutters, of size recommended by SMACNA but not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters.
 1. Gutter Style: SMACNA designation A.
 2. Expansion Joints: Built in.
 3. Gutters with Girth up to 15 Inches (380 mm): Fabricate from the following materials:
 - a. Galvanized Steel: 0.028 inch (0.56 mm)] thick.
- B. Downspouts: Fabricate rectangular downspouts complete with mitered elbows. Furnish with metal hangers, from same material as downspouts, and anchors.
 1. Fabricated Hanger Style: SMACNA figure designation 1-35A.
 2. Fabricate from the following materials:
 - a. Galvanized Steel: 0.022 inch (0.56 mm) thick.
- C. Parapet Scuppers: Fabricate scuppers of dimensions indicated on drawings. Fabricate from the following materials:
 - a. Stainless Steel: 0.019 inch (0.48 mm).

- D. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape indicated complete with outlet tubes and built-in overflows. Fabricate from the following materials:
 - 1. Galvanized Steel: 0.028 inch (0.71 mm) thick.
- E. Splash Pans: Fabricate from the following materials:
 - a. Stainless Steel: 0.019 inch (0.48 mm).

2.5 MISCELLANEOUS SHEET METAL FABRICATIONS

- A. Equipment Support Flashing: Fabricate from the following materials:
 - 1. Galvanized Steel: 0.028 inch (0.71 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.
 - 1. Verify compliance with requirements for installation tolerances of substrates.
 - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 - 1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 - 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 - 3. Space cleats not more than 12 inches (300 mm) apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
 - 4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
 - 5. Install sealant tape where indicated.
 - 6. Torch cutting of sheet metal flashing and trim is not permitted.
 - 7. Do not use graphite pencils to mark metal surfaces.

- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.
- 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 wood sheathing not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws and 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."

3.3 ROOF DRAINAGE SYSTEM INSTALLATION

- A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.
- B. Hanging Gutters: Join sections with riveted and soldered joints or with lapped joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchored gutter brackets spaced not more than 36 inches (900 mm) apart. Provide end closures and seal watertight with sealant. Slope to downspouts.
 - 1. Fasten gutter spacers to front and back of gutter.
 - 2. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 24 inches (600 mm) apart.
 - 3. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet (15.24 m) apart. Install expansion-joint caps.
- C. Downspouts: Join sections with 1-1/2-inch (38-mm) telescoping joints.
 - 1. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches (1500 mm) o.c. in between.
 - 2. Provide elbows at base of downspout to direct water away from building.
- D. Splash Pans: Install where downspouts discharge on low-slope roofs. Set in elastomeric sealant compatible with roofing membrane.
- E. Parapet Scuppers: Install scuppers where indicated through parapet. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.

3.4 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
- B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at 16-inch (400-mm) centers.
- C. Copings: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated.
 - 1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 16-inch (400-mm) centers.
 - 2. Anchor interior leg of coping with screw fasteners and washers at 20-inch (500-mm) centers.
- D. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches (100 mm) over base flashing. Lap counterflashing joints a minimum of 4 inches (100 mm) and bed with sealant. Secure in a waterproof manner by means of interlocking folded seam or blind rivets and sealant.
- E. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.5 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

3.6 MISCELLANEOUS FLASHING INSTALLATION

- A. 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.

3.7 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.

3.8 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean off excess sealants.
- C. 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.
- D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 6200

SECTION 077253 - SNOW GUARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Rail-type, seam-mounted snow guards.

1.3 ACTION SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for snow guards.
- B. Shop Drawings: Include roof plans showing layouts and attachment details of snow guards.
 - 1. Include calculation of number and location of snow guards based on snow load, roof slope, roof type, components, spacings, and finish.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of snow guard, for tests performed by manufacturer and witnessed by a qualified testing agency.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Performance Requirements: Provide snow guards that withstand exposure to weather and resist thermally induced movement without failure, rattling, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- B. Structural Performance:
 - 1. Snow Loads: Insert loading requirements.

2.2 RAIL MOUNTED SNOW GUARDS

- A. Rail-Mounted Metal Snow Guard:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Alpine SnowGuards; a division of Vermont Slate & Copper Services, Inc.
 - b. Berger Building Products.
 - c. Roofers Edge.
 - d. SnoGuard.
2. Finish and Color: Powder coat; color as selected by Architect from manufacturer's full range.

2.3 STANDING SEAM CLIP

- A. Clamp for attaching snow guard system to standing seam roof systems with penetrating or piercing the panel
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. PMC Industries, Inc.
 - b. S-5!

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, snow guard attachment, and other conditions affecting performance of the Work.
 1. Verify compatibility with and suitability of substrates including compatibility with existing finishes or primers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean and prepare substrates for bonding snow guards.
- B. Prime substrates according to snow guard manufacturer's written instructions.

3.3 INSTALLATION

- A. Install snow guards according to manufacturer's written instructions. Space rows as recommended by manufacturer where indicated on drawings.
- B. Attachment for Metal Roofing:
 1. Rail-Mounted, Snow Guard Pads: Seam clamp.

END OF SECTION 077253

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Penetrations in fire-resistance-rated walls.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.1: For penetration firestopping sealants and sealant primers, documentation including printed statement of VOC content.
- C. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.
 - 1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for penetration firestopping.

1.5 QUALITY ASSURANCE

- A.
- B. Installer Qualifications: A firm experienced in installing penetration firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to

sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

- C. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:
1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
 2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.
 - b. Classification markings on penetration firestopping correspond to designations listed by the following:
 - 1) UL in its "Fire Resistance Directory."
 - 2)

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping when ambient or substrate temperatures are outside limits permitted by penetration firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. A/D Fire Protection Systems Inc.
 2. Grace Construction Products.
 3. Hilti, Inc.
 4. Johns Manville.
 5. 3M Fire Protection Products.
 6. Tremco, Inc.; Tremco Fire Protection Systems Group.

2.2 PENETRATION FIRESTOPPING

- A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
- B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
 - 1. Fire-resistance-rated walls include fire walls fire-barrier walls.
 - 2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. VOC Content: Penetration firestopping sealants and sealant primers shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Sealants: 250 g/L.
 - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 3. Sealant Primers for Porous Substrates: 775 g/L.
- D. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.

2.3 FILL MATERIALS

2.4 MIXING

- A. For those products requiring mixing before application, comply with penetration firestopping manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with manufacturer's written instructions and with the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.

2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.3 INSTALLATION

- A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.
- C. Install fill materials for firestopping by proven techniques to produce the following results:
1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 2. Contractor's name, address, and phone number.
 3. Designation of applicable testing and inspecting agency.
 4. Date of installation.
 5. Manufacturer's name.
 6. Installer's name.

3.5 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping is without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping and install new materials to produce systems complying with specified requirements.

3.6 PENETRATION FIRESTOPPING SCHEDULE

- A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.
- B. Firestopping with No Penetrating Items[**FS-<#>**]:
 - 1. UL-Classified Systems: [C-AJ-] [C-BJ-] [F-A-] [F-B-] [F-C-] [W-J-] [W-L-] <Insert four-digit number> [0001-0999].
 - 2. Type of Fill Materials: As required to achieve rating.
- C. Firestopping for Metallic Pipes, Conduit, or Tubing[**FS-<#>**]:
 - 1. UL-Classified Systems: [C-AJ-] [C-BJ-] [C-BK-] [F-A-] [F-B-] [F-C-] [F-E-] [W-J-] [W-K-] [W-L-] [W-N-] <Insert four-digit number> [1001-1999].
 - 2. Type of Fill Materials: As required to achieve rating.
- D. Firestopping for Nonmetallic Pipe, Conduit, or Tubing[**FS-<#>**]:
 - 1. UL-Classified Systems: [C-AJ-] [C-BJ-] [C-BK-] [F-A-] [F-B-] [F-C-] [F-E-] [W-J-] [W-K-] [W-L-] [W-N-] <Insert four-digit number> [2001-2999].
 - 2. Type of Fill Materials: As required to achieve rating.
- E. Firestopping for Electrical Cables[**FS-<#>**]:
 - 1. UL-Classified Systems: [C-AJ-] [C-BJ-] [C-BK-] [F-A-] [F-B-] [F-C-] [F-E-] [W-J-] [W-K-] [W-L-] <Insert four-digit number> [3001-3999].
 - 2. Type of Fill Materials: As required to achieve rating.
- F. Firestopping for Insulated Pipes[**FS-<#>**]:
 - 1. UL-Classified Systems: [C-AJ-] [C-BJ-] [C-BK-] [F-A-] [F-B-] [F-C-] [F-E-] [W-J-] [W-L-] [W-N-] <Insert four-digit number> [5001-5999].
 - 2. Type of Fill Materials: As required to achieve rating.
- G. Firestopping for Miscellaneous Electrical Penetrants[**FS-<#>**]:
 - 1. UL-Classified Systems: [C-AJ-] [C-BJ-] [F-A-] [W-L-] [W-J-] <Insert four-digit number> [6001-6999].
 - 2. Type of Fill Materials: As required to achieve rating.
- H. Firestopping for Miscellaneous Mechanical Penetrants[**FS-<#>**]:
 - 1. UL-Classified Systems: [C-AJ-] [C-BJ-] [F-A-] [F-B-] [F-C-] [F-E-] [W-J-] [W-L-] [W-N-] <Insert

- four-digit number**> [7001-7999].
2. Type of Fill Materials: As required to achieve rating.
- I. Firestopping for Groupings of Penetrants[**FS-<#>**]:
1. UL-Classified Systems: [**C-AJ-**] [**C-BJ-**] [**F-A-**] [**F-B-**] [**F-C-**] [**F-E-**] [**W-J-**] [**W-L-**] <Insert **four-digit number**> [8001-8999].
 2. Type of Fill Materials: As required to achieve rating.

END OF SECTION 078413

SECTION 07 9200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Silicone joint sealants.
2. Latex joint sealants.
3. Acoustical joint sealants.

- B. Related Sections:

1. Division 07 Section "Fire-Resistive Joint Systems" for sealing joints in fire-resistance-rated construction.
2. Division 08 Section "Glazing" for glazing sealants.
3. Division 09 Section "Gypsum Board" for sealing perimeter joints.
4. Division 32 Section "Concrete Paving Joint Sealants" for sealing joints in pavements, walkways, and curbing.

1.3 PRECONSTRUCTION TESTING

- A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Submit not fewer than eight pieces of each kind of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

- B. Preconstruction Stain Testing, Silicone Sealants: Submit to joint sealant manufacturer for silicone sealants to be used in masonry, stone, and similar porous joints, the actual joint materials for testing in accordance with ASTM C124B, to determine whether the sealants to be used will cause staining of the surrounding joint materials. Schedule sufficient time for testing and analyzing results to prevent delaying the Work. For sealant materials failing tests, obtain joint sealant manufacturer' written requirements for the products and procedures to be used to result in no staining.

1.4 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.1: For sealants and sealant primers used inside the weatherproofing system, documentation including printed statement of VOC content.
 - 2. Laboratory Test Reports for Credit IEQ 4: For sealants and sealant primers used inside the weatherproofing system, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- 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.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
- D. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
- C. Product Testing: Test joint sealants using a qualified testing agency.
 - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.

1.7 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
 2. When joint substrates are wet.
 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.8 WARRANTY

- A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period: Two years from date of Final Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance, including non-staining of adjacent materials, and other requirements specified in this Section within specified warranty period.
- C. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:
 1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
 2. Disintegration of joint substrates from natural causes exceeding design specifications.
 3. Mechanical damage caused by individuals, tools, or other outside agents.
 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Architectural Sealants: 250 g/L.
 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 3. Sealant Primers for Porous Substrates: 775 g/L.
- C. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- D. 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.
- E. 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.
- F. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

- A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant ES-1: ASTM C 920, Type S, Grade NS, Class 50, for Use NT.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 791.
 - b. Pecora Corporation; 864.
 - c. Tremco Incorporated; Spectrem 3.
- B. Single-Component, Pourable, Traffic-Grade, Neutral-Curing Silicone Joint Sealant ES-2: ASTM C 920, Type S, Grade P, Class 100/50, for Use T.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 890-SL.
 - b. Pecora Corporation; 300 SL.
 - c. Tremco Incorporated; Spectrem 900 SL.
- C. Mildew-Resistant, Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant ES-3: 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. Pecora Corporation; 898.
 - b. Tremco; Tremsil 600 White.

2.3 LATEX JOINT SEALANTS

- A. Latex Joint Sealant LS-1: 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. Pecora Corporation; AC-20+.
- b. Tremco Incorporated; Tremflex 834.

2.4 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Joint Sealant AS-1: 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.

2.5 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) or Type B (bicellular material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- 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.

2.6 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.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.

3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
1. Place sealants so they directly contact and fully wet joint substrates.
 2. Completely fill recesses in each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealant from surfaces adjacent to joints.
 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
 4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.
 5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.
- G. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations.

3.4 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.

3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.6 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces (ES-1).
1. Joint Locations:
 - a. Joints between metal panels.
 - b. Joints between different materials listed above
 - c. Perimeter joints between materials listed above and frames of doors, windows, and louvers
 2. Silicone Joint Sealant: Single component, nonsag, neutral curing, Class 50.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application: Interior joints in horizontal traffic surfaces (ES-2).
1. Joint Locations:
 - a. Isolation joints in cast-in-place concrete slabs.
 - b. Control and expansion joints in tile flooring.
 2. Silicone Joint Sealant: Single component, pourable, traffic grade, neutral curing.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces (LS-1).
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 and windows.
 2. Joint Sealant: Latex.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- D. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces (ES-3).
1. Joint Sealant Location:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 2. Joint Sealant: Mildew resistant, single component, nonsag, neutral curing, Silicone or Single component, nonsag, mildew resistant, acid curing.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- E. Joint-Sealant Application: Interior acoustical joints in vertical surfaces and horizontal nontraffic surfaces (AS-1).
1. Joint Location:
 - a. Acoustical joints where indicated.
 2. Joint Sealant: Acoustical.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

END OF SECTION 07 9200

SECTION 08 1113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Standard hollow metal doors and frames.
- B. Related Sections:
 - 1. Division 08 Section "Door Hardware" for door hardware for hollow metal doors.
 - 2. Division 09 Sections "Exterior Painting" and "Interior Painting" for field painting hollow metal doors and frames.
 - 3. Division 26 Sections for electrical connections including conduit and wiring for door controls and operators.

1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings.
- B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, temperature-rise ratings, and finishes.
- B. 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 each different wall opening condition.
 - 6. Details of anchorages, joints, field splices, and connections.
 - 7. Details of accessories.
 - 8. Details of moldings, removable stops, and glazing.
 - 9. Details of conduit and preparations for power, signal, and control systems.
 - 10. Fire rated doors and frames showing conformance with NFPA 80 and Underwriters Laboratory, Inc.
- C. LEED Submittals:

1. Recycled Content – Credit MR 4.2: Provide documentation indicating percentages of post-consumer and pre-consumer recycled content by weight per unit of product or assembly containing the product. Indicate the percentage of the dollar of the recycled content compared to the total dollar value of the product or assembly containing the product.
2. Regional Materials – Credit MR 5.2: Where the distance to the Project site is 500 miles or less, indicate location and distance to the Project site of extraction, harvesting, recovery and manufacturing of all materials. Indicate the dollar value of the material cost of the product containing local/regional materials. Where product components are sourced or manufactured in separate locations, provide location and percentage by weight of each component per unit of product.

D. Other Action Submittals:

1. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.

1.5 INFORMATIONAL SUBMITTALS

- A. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of hollow metal door and frame assembly.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.
- B. 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 as close to neutral pressure as possible according to NFPA 252 or UL 10B.
 1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
 2. Temperature-Rise Limit: At vertical exit enclosures 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.

1.7 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 nonvented plastic.
 1. Provide additional protection to prevent damage to finish of factory-finished units.
- 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- (102-mm-) high wood blocking. Do not store in a manner that traps excess humidity.
 - 1. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

1.8 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.9 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amweld Building Products, LLC.
 - 2. Ceco Door Products; an Assa Abloy Group company.
 - 3. Curries Company; an Assa Abloy Group company.
 - 4. Fleming Door Products Ltd.; an Assa Abloy Group company.
 - 5. Steelcraft; an Ingersoll-Rand company.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
- D. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z (12G) coating designation; mill phosphatized.
 - 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

- F. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.
- G. Glazing: Comply with requirements in Division 08 Section "Glazing."
- H. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.3 STANDARD HOLLOW METAL DOORS

- A. General: Provide 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.
 - 1. Design: Flush panel with seamless vertical edges.
 - 2. Core Construction: Manufacturer's standard vertical steel-stiffener core. Stiffeners to be welded to faces. Provide with voids filled with mineral wool insulation.
 - a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
 - b. Thermal-Rated (Insulated) Doors: Where indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than 12.3 deg F x h x sq. ft./Btu (2.166 K x sq. m/W) when tested according to ASTM C 1363.
 - 1) Locations: Exterior doors and interior doors where indicated.
 - 3. Vertical Edges for Single-Acting Doors: Beveled edge.
 - a. Beveled Edge: 1/8 inch in 2 inches (3 mm in 50 mm).
 - 4. Vertical Edges for Double-Acting Doors: Round vertical edges with 2-1/8-inch (54-mm) radius.
 - 5. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- (1.0-mm-) thick, end closures or channels of same material as face sheets. Top closures for outswing exterior wall doors shall be flush to eliminate possibility of catching water.
 - 6. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. 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. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 2 (Seamless). Exterior door faces minimum 16 gage (0.067 inch).
- C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet[unless metallic-coated sheet is indicated]. 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. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 2 (Seamless). Interior door faces minimum 16 gage (0.067 inch).

- D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.
 - 1. When vertical steel stiffeners are used for core construction, fill spaces between stiffeners with mineral fiber insulation.
- F. Fire Rated Doors (labeled)
 - 1. Conform to NFPA 80 when tested by Underwriters Laboratories, Inc., for the class of door or opening shown.
 - 2. Fire rated labels of metal, with raised or incised markings of approving laboratory shall be permanently attached to doors.
 - 3. Close top and vertical edges of doors flush. Vertical edges shall be seamless. Apply steel astragal to the meeting stile of the active leaf of pairs of fire rated doors, except where vertical rod exit devices are specified for both leaves swinging in the same direction.

2.4 STANDARD HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.
- B. Exterior Frames: Fabricated from metallic-coated steel sheet.
 - 1. Fabricate frames with mitered or coped corners.
 - 2. Fabricate frames as full profile welded unless otherwise indicated.
 - 3. Frames for Level 3 Steel Doors: 0.075-inch- (1.9-mm-) thick steel sheet.
- C. Interior Frames: Fabricated from cold-rolled steel sheet unless metallic-coated sheet is indicated.
 - 1. Fabricate frames with mitered or coped corners.
 - 2. Fabricate frames as full profile welded unless otherwise indicated.
 - 3. Frames for Level 3 Steel Doors: 0.067-inch- (1.7-mm-) thick steel sheet. 0.075-inch- (1.9-mm) for frames exceeding 48 inches in width.
 - 4. Frames for Wood Doors: 0.067-inch- (1.7-mm-) thick steel sheet. 0.075-inch- (1.9-mm) for frames exceeding 48 inches in width.
 - 5. Frames for Borrowed Lights: 0.067-inch- (1.7-mm-) thick steel sheet. 0.075-inch- (1.9-mm) for frames exceeding 48 inches in width.
- D. Frames for labeled fire rated doors.
 - 1. Comply with NFPA 80. Test by Underwriters Laboratories, Inc.
 - 2. Fire rated labels of approving laboratory permanently attached to frames as evidence of conformance with these requirements. Provide labels of metal or engraved stamp, with raised or incised markings.
- E. Knocked Down frames are not acceptable.
- F. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
- B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch (1.0 mm) thick, and as follows:
 - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
 - 2. Where floor fills occur, provide extension type floor anchors to compensate for depth of fill.
 - 3. At bottom of jamb use 1.3mm (0.053 inch) thick steel clip angles welded to jamb and drilled to receive two 6 mm (1/4 inch) floor bolts. Use 50 mm x 50 mm (2 inch by 2 inch) 9 mm by (3/8 inch) clip angle for lead lined frames, drilled for 9 mm (3/8 inch) floor bolts.
 - 4. Where mullions occur, provide 2.3 mm (0.093 inch) thick steel channel anchors, drilled for 6mm (1/4 inch) floor bolts and frame anchor screws.
 - 5. Where sill sections occur, provide continuous 1 mm (0.042 inch) thick steel rough bucks drilled for 6mm (1/4 inch) floor bolts and frame anchor screws. Space floor bolts at 50 mm (24 inches) on center.

2.6 STOPS AND MOLDINGS

- A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch (0.8 mm) thick, fabricated from same material as door face sheet in which they are installed.
- B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated.
- C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch (0.8 mm) thick, fabricated from same material as frames in which they are installed.

2.7 ACCESSORIES

- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- B. Ceiling Struts: Minimum 1/4-inch-thick by 1-inch- (6.4-mm-thick by 25.4-mm-) wide steel.
- C. Grout Guards: Formed from same material as frames, not less than 0.016 inch (0.4 mm) thick.
- D. Grout Boxes: Formed from same materials as frames at locations indicated to receive installation of electrical conduit for power or data wiring.

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. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

- B. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.
- C. Hollow Metal Doors:
1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
 2. Glazed Lites: Factory cut openings in doors.
 3. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch (19 mm) beyond edge of door on which astragal is mounted.
- D. Hollow Metal Frames: 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.
1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 2. 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.
 3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 4. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
 5. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 6. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
 - 1) Two anchors per jamb up to 60 inches (1524 mm) high.
 - 2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
 - 3) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high.
 - 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 120 inches (3048 mm) high.
 - b. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches (1524 mm) high.
 - 2) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
 - 3) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.
 - 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 96 inches (2438 mm) high.
 - 5) Two anchors per head for frames above 42 inches (1066 mm) wide and mounted in metal-stud partitions.
 - c. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.

7. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.
- F. Hardware Preparation: Factory prepare hollow metal work to receive templated 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 nontemplated, 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.
- G. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
 1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
 4. Provide loose stops and moldings on inside of hollow metal work.
 5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

2.9 STEEL FINISHES

- A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
 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; compatible with substrate and field-applied coatings despite prolonged exposure.

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 embedded and built-in anchors to verify actual locations before frame installation.
- C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. 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 to the following tolerances:
 - 1. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - 2. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - 3. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - 4. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a perpendicular line from head to floor.
- C. Drill and tap doors and frames to receive nontemplated, 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.
 - 1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-protection-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable glazing stops located on secure side of opening.
 - d. Install door silencers in frames before grouting.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - g. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
 4. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.
 5. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.
- 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 (3 mm) plus or minus 1/16 inch (1.6 mm).
 - b. Between Edges of Pairs of Doors: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
 - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch (9.5 mm).
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch (19 mm).
 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
 3. Smoke-Control Doors: Install doors according to NFPA 105.
- D. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.
1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (50 mm) o.c. from each corner.
- 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 Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

- D. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 08 1113

SECTION 08 1416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Solid-core doors with wood-veneer faces.
2. Factory finishing flush wood doors.
3. Factory machining for hardware

- B. Related Sections:

1. Division 08 Section "Glazing" for glass view panels in flush wood doors.
2. Division 08 Section "Door Hardware" for hardware on wood doors.
3. Division 08 Section "Hollow Metal Doors and Frames" for wood doors in steel frames.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of door indicated. Include details of core and edge construction and trim for openings. Include factory-finishing specifications.

- B. LEED Submittals:

1. Certificates for Credit MR 7: Chain-of-custody certificates indicating that flush wood doors comply with forest certification requirements. Include documentation that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.
2. Product Data for Credit IEQ 4.4: For adhesives and composite wood products, documentation indicating that product contains no urea formaldehyde.

- C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.

1. Indicate dimensions and locations of mortises and holes for hardware.
2. Indicate dimensions and locations of cutouts.
3. Indicate requirements for veneer matching.
4. Indicate doors to be factory finished and finish requirements.
5. Indicate fire-protection ratings for fire-rated doors.
6. Labeled fire rated doors showing conformance w/ NFPA 80.

- D. Samples for Initial Selection: For factory-finished doors.
- E. Samples for Verification:
 - 1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches (200 by 250 mm), for each material and finish.

1.4 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.
- B. Laboratory Test Reports:
 - 1. Screw holding capacity test report in accordance with WDMA T.M. 10.
 - 2. Split resistance test report in accordance with WDMA T.M. 5.
 - 3. Sycle/slam test report in accordance with WDMA T.M. 8.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- B. Source Limitations: Obtain flush wood doors from single manufacturer.
- C. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, "Architectural Wood Flush Doors."

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 PROJECT CONDITIONS

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

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:

- a. Warping (bow, cup, or twist) more than 1/4 inch (6.4 mm) in a 42-by-84-inch (1067-by-2134-mm) section.
 - b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm in a 76.2-mm) span.
- 2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
 - 3. Warranty Period for Solid-Core Interior Doors: Life of installation.

1.9 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extend referenced publications are referenced in text by basic designation only.
- B. Window and Door Manufacturers Association (WDMA):
 - 1. I.S. 1-A-04 Architectural Wood Flush Doors
 - 2. I.S. 4-07A Water-Repellent Preservative Non-Pressure Treatment for Millwork
 - 3. I.S.6A-01 Architectural Wood Stile and Rail Doors
 - 4. T.M. 5-90 Split resistance Test Method
 - 5. T.M. 6-08 Adhesive (Glue Bond) Durability Test Method
 - 6. T.M. 7-08 Cycle-Slam Test Method
 - 7. T.M. 8-08 Hinge Loading Test Method
 - 8. T.M.10-08 Screwholding Test Method
- C. National Fire Protection Association (NFPA):
 - 1. 80-07 Protection of Buildings from Exterior Fire
 - 2. 252-08 Fire Tests of Door Assemblies
- D. ASTM International (ASTM):
 - 1. E90-04 Laboratory Measurements of Airborne Sound Transmission Loss

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Algoma Hardwoods, Inc.
 - 2. Eggers Industries.
 - 3. Graham; an Assa Abloy Group company.
 - 4. VT Industries Inc.

2.2 DOOR CONSTRUCTION, GENERAL

- A. Certified Wood: Fabricate doors with all wood products produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

- B. Low-Emitting Materials: Fabricate doors with adhesives and composite wood products that do not contain urea formaldehyde.
- C. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.
- D. Particleboard-Core Doors:
 - 1. Particleboard: ANSI A208.1, Grade LD-2, made with binder containing no urea-formaldehyde resin.
 - 2. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
 - 3. Provide doors with structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.
- E. Structural-Composite-Lumber-Core Doors:
 - 1. Structural Composite Lumber: WDMA I.S.10.
 - a. Screw Withdrawal, Face: 700 lbf (3100 N).
 - b. Screw Withdrawal, Edge: 400 lbf (1780 N).
- F. Mineral-Core Doors:
 - 1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
 - 2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as needed to eliminate through-bolting hardware.
 - 3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

2.3 VENEERED-FACED DOORS FOR TRANSPARENT FINISH

- A. Interior Solid-Core Doors:
 - 1. Grade: Premium, with Grade A faces.
 - 2. Species: Red oak.
 - 3. Cut: Plain sliced (flat sliced).
 - 4. Match between Veneer Leaves: Book match.
 - 5. Assembly of Veneer Leaves on Door Faces: Running match.
 - 6. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
 - 7. Exposed Vertical Edges: Same species as faces.
 - 8. Core: Particleboard or structural composite lumber.
 - 9. Construction: Five plies. Stiles and rails are bonded to core, then entire unit abrasive planed before veneering. Faces are bonded to core using a hot press.
 - 10. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.

2.4 LIGHT FRAMES

- A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads as follows unless otherwise indicated.
 - 1. Wood Species: Same species as door faces.
 - 2. Profile: Manufacturer's standard shape.
 - 3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.

2.5 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 - 1. Comply with requirements in NFPA 80 for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
 - 1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
 - 2. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
 - 3. Provide factory application of sealer to edge and routings.
- C. Openings: Cut and trim openings through doors in factory.
 - 1. Light Openings: Trim openings with moldings of material and profile indicated.
 - 2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Division 08 Section "Glazing."

2.6 IDENTIFICATION MARK

- A. On top edge of door.
- B. Provide either a stamp, brand or other indelible mark, giving manufacturer's name, door's trade name, construction of door, code date of manufacture and quality
- C. Accompanied by either of the following additional requirements:
 - 1. An identification mark or a separate certification including name of inspection organization
 - 2. Identification of standards for door, including glue type.
 - 3. Identification of veneer and quality certification.
 - 4. Identification of preservative treatment for stile and rail doors.

2.7 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.

1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.
- B. Finish doors at factory.
- C. Finish doors at factory that are indicated to receive transparent finish. Field finish doors indicated to receive opaque finish.
- D. Transparent Finish:
 1. Grade: Premium.
 2. Finish: WDMA TR-6 catalyzed polyurethane.
 3. Staining: As selected by Architect from manufacturer's full range.
 4. Effect: Open-grain finish.
 5. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

- A. Hardware: For installation, see Division 08 Section "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.
 1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.
- C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
 1. Clearances: Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors. Provide 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold unless otherwise indicated.
 - a. Comply with NFPA 80 for fire-rated doors.
 2. Bevel non-fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.
 3. Bevel fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock edge; trim stiles and rails only to extent permitted by labeling agency.

- D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

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

3.4 DOOR PROTECTION

- A. As door installation is completed, place polyethylene bag or cardboard shipping container over door and tape in place
- B. Provide protective covering over knobs and handles in addition to covering door.
- C. Maintain covering in good condition until removal is approved by Owner.

END OF SECTION 08 1416

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Access doors and frames for walls.
- B. Related Sections include the following:
 - 1. Division 09 Section "Metal Framing" and "Gypsum Board" for mounting in metal stud construction.

1.3 SUBMITTALS

- A. Product Data: For each type of access door and frame indicated. Include construction details, materials, individual components and profiles, and finishes.
- B. Shop Drawings: Show fabrication and installation details of access doors and frames for each type of substrate. Include plans, elevations, sections, details, and attachments to other work.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain access door(s) and frame(s) through one source from a single manufacturer.
- B. Size Variations: Obtain Architect's acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.

1.5 COORDINATION

- A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, or other concealed work, and indicate in the schedule specified in "Submittals" Article.

PART 2 - PRODUCTS

2.1 STEEL MATERIALS

- A. Drywall Beads: Edge trim formed from 0.0299-inch (0.76-mm) zinc-coated steel sheet formed to receive joint compound and in size to suit thickness of wall construction.

2.2 STAINLESS-STEEL MATERIALS

- A. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304. Remove tool and die marks and stretch lines or blend into finish.
 - 1. Finish: Manufacturer's standard.

2.3 ACCESS DOORS AND FRAMES FOR WALLS

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

1. Dur-Red Products.
2. J. L. Industries, Inc.
3. Larsen's Manufacturing Company.
4. Milcor Inc.
5. Nystrom, Inc.

B. Flush Access Doors and Trimless Frames: Fabricated from stainless-steel sheet.

1. Locations: Wall surfaces.
2. Size: 18 inches by 18 inches.
3. Quantity: As shown in plans.
4. Door: Minimum 0.060-inch- (1.5-mm-) thick sheet metal, set flush with surrounding finish surfaces.
5. Frame: Minimum 0.060-inch- (1.5-mm-) thick sheet metal with drywall bead flange where occurs.
6. Hinges: Continuous piano.
7. Lock: Cylinder.

2.4 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
 1. For trimless frames with drywall bead, provide edge trim for gypsum board securely attached to perimeter of frames.
 2. Provide mounting holes in frames for attachment of units to metal or wood framing.
 3. Provide mounting holes in frame for attachment of masonry anchors. Furnish adjustable metal masonry anchors.
- D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
 1. For cylinder lock, furnish two keys per lock and key all locks alike.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.
- C. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.2 ADJUSTING AND CLEANING

- A. Adjust doors and hardware after installation for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 083113

SECTION 083613 - SECTIONAL DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes electrically operated sectional doors.
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications" for miscellaneous steel supports.
 - 2. Section 087100 "Door Hardware" for locksets installed into sectional door.
 - 3. Section 133419 "Metal Building Systems" for structural steel building supports.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type and size of sectional door and accessory.
 - 1. Include construction details, material descriptions, dimensions of individual components, profile door sections, and finishes.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies. Indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
 - 4. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: For units with factory-applied finishes.
 - 1. Include Samples of accessories involving color selection.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sectional doors to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of sectional doors that fail in materials or workmanship within specified warranty period.

- 1. Failures include, but are not limited to, the following:

- a. Structural failures including, but not limited to, excessive deflection.
- b. Failure of components or operators before reaching required number of operation cycles.
- c. Faulty operation of hardware.
- d. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use; rust through.
- e. Delamination of exterior or interior facing materials.

- 2. Warranty Period: Five years from date of Substantial Completion.

- B. Special Finish Warranty: Manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.

- 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS, GENERAL

- A. Source Limitations: Obtain sectional doors from single source from single manufacturer.

- 1. Obtain operators and controls from sectional door manufacturer.

2.2 DOOR ASSEMBLY

- A. Operation Cycles: Door components and operators capable of operating for not less than 50,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

- B. Air Infiltration: Maximum rate of 0.08 cfm/sq. ft. at 15 and 25 mph when tested according to ASTM E 283.

- C. R-Value: 17.5 deg F x h x sq. ft./Btu.

- D. Steel Sections: Zinc-coated (galvanized) steel sheet with G90 zinc coating.

- 1. Section Thickness: 2 inches .

SECTIONAL DOORS

2. Exterior-Face, Steel Sheet Thickness: Insert dimension nominal coated thickness.
 - a. Surface: Manufacturer's standard, grooved .
 3. Insulation: Foamed in place.
 4. Interior Facing Material: Zinc-coated (galvanized) steel sheet with a nominal coated thickness of 0.019 inch.
- E. Track Configuration: High-lift track
- F. Weatherseals: Fitted to bottom and top and around entire perimeter of door. Provide combination bottom weatherseal and sensor edge.
- G. Windows: Approximately 24 by 11 inches and spaced apart the approximate distance as indicated on Drawings; in one row(s) at height indicated on Drawings; installed with glazing of the following type:
1. Insulating Glass: Manufacturer's standard.
- H. Roller-Tire Material: Manufacturer's standard.
- I. Locking Devices: Equip door with slide bolt for padlock.
- J. Counterbalance Type: Torsion spring.
- K. Electric Door Operator:
1. Usage Classification: Heavy duty, 25 or more cycles per hour and more than 90 cycles per day.
 2. Operator Type: Manufacturer's standard for door requirements.
 3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use[; **moving parts of operator enclosed or guarded if exposed and mounted at 8 feet or lower**].
 4. Motor Exposure: Interior, clean, and dry.
 5. Emergency Manual Operation: Push-up type.
 6. Obstruction-Detection Device: Automatic electric sensor edge on bottom section .
 - a. Sensor Edge Bulb Color: Black.
 7. Other Equipment: .
- L. Door Finish:
1. Baked-Enamel or Powder-Coat Finish: Color and gloss as selected by Contracting Officer from manufacturer's full range.
 2. Finish of Interior Facing Material: Finish as selected by Contracting Officer from manufacturer's full range.

2.3 MATERIALS, GENERAL

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.4 STEEL DOOR SECTIONS

- A. Exterior Section Faces and Frames: Zinc-coated (galvanized), cold-rolled, commercial steel (CS) sheet, complying with ASTM A 653/A 653M, with indicated zinc coating and thickness.

1. Fabricate section faces from single sheets to provide sections not more than 24 inches high and of indicated thickness. Roll horizontal meeting edges to a continuous, interlocking, keyed, rabbeted, shiplap, or tongue-in-groove weather-resistant seal, with a reinforcing flange return.
 2. For insulated doors, provide sections with continuous thermal-break construction, separating the exterior and interior faces of door.
- B. Section Ends and Intermediate Stiles: Enclose open ends of sections with channel end stiles formed from galvanized-steel sheet not less than 0.064-inch- nominal coated thickness and welded to door section. Provide intermediate stiles formed from not less than 0.064-inch- thick galvanized-steel sheet, cut to door section profile, and welded in place. Space stiles not more than 48 inches apart.
- C. Reinforce bottom section with a continuous channel or angle conforming to bottom-section profile.
- D. Reinforce sections with continuous horizontal and diagonal reinforcement, as required to stiffen door and for wind loading. Provide galvanized-steel bars, struts, trusses, or strip steel, formed to depth and bolted or welded in place. Ensure that reinforcement does not obstruct vision lites.
- E. Provide reinforcement for hardware attachment.
- F. Foamed-in-Place Thermal Insulation: Insulate interior of steel sections with door manufacturer's standard CFC-free polyurethane insulation, foamed in place to completely fill interior of section and pressure bonded to face sheets to prevent delamination under wind load, and with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within steel sections and the interior facing material, with no exposed insulation.
- G. Interior Facing Material: Zinc-coated (galvanized), cold-rolled, commercial steel (CS) sheet, complying with ASTM A 653/A 653M, with indicated thickness.
- H. Fabricate sections so finished door assembly is rigid and aligned, with tight hairline joints and free of warp, twist, and deformation.

2.5 TRACKS, SUPPORTS, AND ACCESSORIES

- A. Tracks: Manufacturer's standard, galvanized-steel track system of configuration indicated, sized for door size and weight, designed for lift type indicated and clearances indicated on Drawings, Provide complete system including brackets, bracing, and reinforcement to ensure rigid support of ball-bearing roller guides for required door type, size, weight, and loading.
1. Galvanized Steel: ASTM A 653/A 653M, minimum G60 zinc coating.
 2. Slope tracks at an angle from vertical or design tracks to ensure tight closure at jambs when door unit is closed.
 3. Track Reinforcement and Supports: Galvanized-steel members to support track without sag, sway, and vibration during opening and closing of doors. Slot vertical sections of track spaced 2 inches apart for door-drop safety device.
 - a. For Horizontal Track: Continuous reinforcing angle from curve in track to end of track, attached to track and supported at points by laterally braced attachments to overhead structural members.
- B. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom and top of sectional door unless otherwise indicated.

- C. Windows: Manufacturer's standard window units of type, size, and in arrangement indicated. Set glazing in vinyl, rubber, or neoprene glazing channel for metal-framed doors and elastic glazing compound for wood doors, as required. Provide removable stops of same material as door-section frames.

2.6 HARDWARE

- A. General: Heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless-steel, or other corrosion-resistant fasteners, to suit door type.
- B. Hinges: Heavy-duty, galvanized-steel hinges of not less than 0.079-inch-nominal coated thickness at each end stile and at each intermediate stile, according to manufacturer's written recommendations for door size. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is impossible. Provide double-end hinges where required, for doors more than 16 feet wide unless otherwise recommended by door manufacturer.
- C. Rollers: Heavy-duty rollers with steel ball-bearings in case-hardened steel races, mounted with varying projections to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Provide 3-inch- diameter roller tires for 3-inch- wide track and 2-inch- diameter roller tires for 2-inch- wide track.

2.7 LOCKING DEVICES

- A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on single-jamb side, operable from inside only. Exterior operation shall be by keyed lockset provided in section 087100.
- B. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.8 COUNTERBALANCE MECHANISM

- A. Torsion Spring: Counterbalance mechanism consisting of adjustable-tension torsion springs fabricated from steel-spring wire complying with ASTM A 229/A 229M, mounted on torsion shaft made of steel tube or solid steel. Provide springs designed for number of operation cycles indicated.
- B. Cable Drums and Shaft for Doors: Cast-aluminum or gray-iron casting cable drums mounted on torsion shaft and grooved to receive door-lifting cables as door is raised. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of torsion shaft. Provide one additional midpoint bracket for shafts up to 16 feet long and two additional brackets at one-third points to support shafts more than 16 feet long unless closer spacing is recommended by door manufacturer.
- C. Cables: Galvanized-steel, multistrand, lifting cables with cable safety factor of at least 5 to 1.
- D. Cable Safety Device: Include a spring-loaded steel or spring-loaded bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if either lifting cable breaks.
- E. Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level the shaft and prevent sag.
- F. Bumper: Provide spring bumper at each horizontal track to cushion door at end of opening operation.

2.9 ELECTRIC DOOR OPERATORS

- A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and "operation cycles" requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
1. Manufacturers: Subject to compliance with requirements, provide electric door operator by same manufacturer as section door.
 2. Comply with NFPA 70.
 3. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6; with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc.
- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.
- C. Door-Operator Type: Unit consisting of electric motor, gears, pulleys, belts, sprockets, chains, and controls needed to operate door and meet required usage classification.
- D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated.
1. Electrical Characteristics:
 - a. Phase: Single phase.
 - b. Volts: 115V.
 - c. Hertz: 60.
 2. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
 3. Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
 4. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
 5. Use adjustable motor-mounting bases for belt-driven operators.
- E. Limit Switches: Equip motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
- F. Obstruction Detection Device: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.
1. Electric Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom section. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
 - a. Self-Monitoring Type: Four-wire configured device designed to interface with door-operator control circuit to detect damage to or disconnection of sensor edge.
- G. Emergency Manual Operation: Equip electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.

- H. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- I. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

2.10 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" 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.

2.11 STEEL AND GALVANIZED-STEEL FINISHES

- A. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Tracks:
 - 1. Fasten vertical track assembly to opening jambs and framing, spaced not more than 24 inches apart.
 - 2. Hang horizontal track assembly from structural overhead framing with angles or channel hangers attached to framing by welding or bolting, or both. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.
- C. Accessibility: Install sectional doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.
- D. Power-Operated Doors: Install automatic garage doors openers according to UL 325.

SECTIONAL DOORS

3.3 STARTUP SERVICES

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust doors and seals to provide weather-resistant fit around entire perimeter.
- D. Touch-up Painting: Immediately after welding galvanized materials, clean welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A 780/A 780M.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional doors.

END OF SECTION 083613

SECTION 08 4113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Exterior and interior storefront framing and windows.
 - 2. Exterior and interior manual-swing entrance doors and door-frame units.

1.3 DEFINITIONS

- A. ADA/ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disability Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:
 - 1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
 - 2. Dimensional tolerances of building frame and other adjacent construction.
 - 3. Failure includes the following:
 - a. Deflection exceeding specified limits.
 - b. Thermal stresses transferring to building structure.
 - c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
 - d. Noise or vibration created by wind and by thermal and structural movements.
 - e. Loosening or weakening of fasteners, attachments, and other components.
 - f. Sealant failure.
 - g. Failure of operating units.
- B. Delegated Design: Design aluminum-framed systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Structural Loads:
 - 1. Wind Loads: As indicated on Drawings.

2. Blast Loads for Exterior Locations: Designed to meet UFC 4-010-01, dated February 9, 2012 including Change 1, dated October 1, 2013 with Applicable Explosive Wt. I.
- D. Deflection of Framing Members:
1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to (13 feet 6 inches) and to 1/240 of clear span plus (1/4 inch) for spans greater than (13 feet 6 inches) or an amount that restricts edge deflection of individual glazing lites to (3/4 inch), whichever is less.
 2. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span or (1/8 inch), whichever is smaller.
- E. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:
1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
 2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
 3. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.
- F. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of (0.06 cfm/sq. ft.) of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of (6.24 lbf/sq. ft.).
- G. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than (6.24 lbf/sq. ft.).
- H. Water Penetration under Dynamic Pressure: Provide aluminum-framed systems that do not evidence water leakage through fixed glazing and framing areas when tested according to AAMA 501.1 under dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than (6.24 lbf/sq. ft.).
1. Maximum Water Leakage: No uncontrolled water penetrating aluminum-framed systems or water appearing on systems' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters that is drained to exterior and water that cannot damage adjacent materials or finishes.
- I. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): (120 deg F), ambient; (180 deg F), material surfaces.
 2. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
 - a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of (180 deg F).
 - b. Low Exterior Ambient-Air Temperature: (0 deg F).

3. Interior Ambient-Air Temperature: (75 deg F).
- J. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 53 when tested according to AAMA 1503.
- K. Thermal Conductance: Provide aluminum-framed systems with fixed glazing and framing areas having an average U-factor of not more than (0.57 Btu/sq. ft. x h x deg F) when tested according to AAMA 1503.
- L. Sound Transmission: Provide aluminum-framed systems with fixed glazing and framing areas having the following sound-transmission characteristics:
 1. Sound Transmission Class (STC): Minimum 35 STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.
- M. Blast Resistance
 1. Provide entrances, storefronts and windows with framing members capable of withstanding a uniform static pressure applied to all glazing surfaces equal to the equivalent 3-second duration design loading determined in accordance with ASTM F2248 using explosive weight I as specified in UFC 4-010-02 and a standoff distance of 151 ft.
 - a. Framing members shall restrict edge deflections of glazing panes to 1/160 of the supported edge length, as determined in accordance with UFC 4-010-01, at allowable stress levels under the equivalent 3-second duration design loading.
 2. Provide entrance and storefront connections to surrounding structural elements, hardware and associated connections, and glazing stop connections capable of withstanding a uniform static shear applied to all glazing surfaces equal to two times the equivalent 3-second duration design loading determined in accordance with ASTM F2248 using explosive weight I as specified in UFC 4-010-02 and a standoff distance of 151 ft.
 - a. Design of connections shall be based upon allowable stress levels. Allowable fastener loads shall be as recommended by the manufacturer for the materials to which glazing systems are being connected.
 - b. Connections shall be capable of preventing the frame from being dislodged from the supporting structural elements, as demonstrated by calculation or testing in accordance with UFC 4-010-01.
 3. For the purpose of determining blast resistance, member, connection, and hardware capacities shall be based on the following:
 - a. Steel: Yield strength.
 - b. Aluminum: 0.2% offset yield strength.
 4. As an alternative to the requirements specified above, provide entrances and storefronts that have been tested in accordance with ASTM F1642 and received a hazard rating of Minimal or better for the peak pressure and positive phase impulse that correspond to each of the following:
 - a. Explosive weight I as specified in UFC 4-010-02 at an effective standoff distance of 151 feet.
 - b. Explosive weight II as specified in UFC 4-010-02 at an effective standoff distance of 33 feet.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum-framed systems.
- B. LEED Submittals:
 - 1. Recycled Content – Credit MR 4.2: Provide documentation indicating percentages of post-consumer and pre-consumer recycled content by weight per unit of product or assembly containing the product. Indicate the percentage of the dollar of the recycled content compared to the total dollar value of the product or assembly containing the product.
 - 2. Regional Materials – Credit MR 5.2: Where the distance to the Project site is 500 miles or less, indicate location and distance to the Project site of extraction, harvesting, recovery and manufacturing of all materials. Indicate the dollar value of the material cost of the product containing local/regional materials. Where product components are sourced or manufactured in separate locations, provide location and percentage by weight of each component per unit of product.
 - 3. Product Data for Credit IEQ 4.1: For glazing sealants used inside of the weatherproofing system, documentation including printed statement of VOC content.
- C. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
 - 2. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.
- D. Samples for Initial Selection: For units with factory-applied color finishes.
- E. Delegated-Design Submittal: For aluminum-framed systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Detail fabrication and assembly of aluminum-framed systems.
 - 2. Include design calculations.
- F. Blast Testing or Analysis Reports: Submit one or more of the following as necessary to demonstrate compliance with all specified requirements for blast resistance.
 - 1. Static test results in accordance with ASTM E330.
 - 2. Airblast test results in accordance with ASTM F1642.
 - 3. Structural analysis data prepared by or under the supervision of a professional engineer
- G. engineered in the design of blast-resistant glazing systems
- H. Qualification Data: For qualified Installer.
- I. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems, indicating compliance with performance requirements.
- J. Warranties: Sample of special warranties.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.
- C. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
 - 1. Do not revise intended aesthetic effects, as judged solely by Contracting Officer, except with Contracting Officer's approval. If revisions are proposed, submit comprehensive explanatory data to Contracting Officer for review.
- D. Accessible Entrances: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.
- E. Source Limitations for Aluminum-Framed Systems: Obtain from single source from single manufacturer.
- F. Preinstallation Conference: Conduct conference at Project site.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration caused by thermal movements.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - d. Water leakage through fixed glazing and framing areas.
 - e. Failure of operating components.
 - 2. Warranty Period: Two years from date of Final Completion.
- B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in

materials or workmanship within specified warranty period. Warranty does not include normal weathering.

1. Warranty Period: 20 years from date of Final Completion.

1.9 MAINTENANCE SERVICE

A. Entrance Door Hardware:

1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
1. EFCO Corporation.
 2. Kawneer North America; an Alcoa company.
 3. Manko Window Systemes, Inc.
 4. TRACO.
 5. Tubelite.
 6. United States Aluminum.

2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
1. Sheet and Plate: (ASTM B 209).
 2. Extruded Bars, Rods, Profiles, and Tubes: (ASTM B 221).
 3. Extruded Structural Pipe and Tubes: ASTM B 429.
 4. Structural Profiles: ASTM B 308/B 308M.
 5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.
- B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
 3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.3 FRAMING SYSTEMS

- A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Full Thermally broken at exterior locations; non-thermally broken at interior locations.
 2. Glazing System: Retained mechanically with gaskets on four sides.
 3. Glazing Plane: Front.
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 2. Reinforce members as required to receive fastener threads.
- D. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- E. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.

2.4 GLAZING SYSTEMS

- A. Glazing: As specified in Division 08 Section "Glazing."
- B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.
- D. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

2.5 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
1. Door Construction: (2-inch) overall thickness, with minimum (0.188-inch-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
 - a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.
 2. Door Design: Wide stile; 5 inch nominal width.
 - a. Accessible Doors: Smooth surfaced for width of door in area within (12 inches) above floor or ground plane.
 3. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.

a. Provide nonremovable glazing stops on outside of door.

B. Entrance Door Hardware: As specified in Division 08 Section "Door Hardware."

2.6 ACCESSORY MATERIALS

A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 07 Section "Joint Sealants."

B. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for (30-mil) thickness per coat.

C. Bent Plates to as detailed on drawings.

1. Match finish of adjacent aluminum frames.

2.7 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
4. Physical and thermal isolation of glazing from framing members.
5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
6. Provisions for field replacement of glazing from interior for vision glass and exterior for spandrel glazing or metal panels.
7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

C. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

D. Storefront Framing: Fabricate components for assembly using screw-spline system.

E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

1. At exterior doors, provide compression weather stripping at fixed stops.
2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.

F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.

- G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.8 ALUMINUM FINISHES

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

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General:
 - 1. Comply with manufacturer's written instructions.
 - 2. Do not install damaged components.
 - 3. Fit joints to produce hairline joints free of burrs and distortion.
 - 4. Rigidly secure nonmovement joints.
 - 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
 - 6. Seal joints watertight unless otherwise indicated.
- B. Metal Protection:
 - 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
 - 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
- D. Set continuous sill members and flashing in full sealant bed as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.
- E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.
- F. Install glazing as specified in Division 08 Section "Glazing."
- G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
 2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.
- H. Install perimeter joint sealants as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.

3.3 ERECTION TOLERANCES

- A. Install aluminum-framed systems to comply with the following maximum erection tolerances:
1. Location and Plane: Limit variation from true location and plane to (1/8 inch in 12 feet); (1/4 inch) over total length.
 2. Alignment:
 - a. Where surfaces abut in line, limit offset from true alignment to (1/16 inch).
 - b. Where surfaces meet at corners, limit offset from true alignment to (1/32 inch).
- B. Diagonal Measurements: Limit difference between diagonal measurements to (1/8 inch).

3.4 FIELD QUALITY CONTROL

- A. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.
- B. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- C. Aluminum-framed assemblies will be considered defective if they do not pass tests and inspections.

3.5 ADJUSTING

- A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.
1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to (3 inches) from the latch, measured to the leading door edge.

END OF SECTION 08 4113

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes:
1. Mechanical door hardware for the following:
 - a. Swinging doors.
 2. Cylinders for door hardware specified in other Sections.
- B. Related Sections:
1. Section 081213 "Hollow Metal Frames"
 2. Section 081416 "Flush Wood Doors"

1.3 REFERENCES

- A. The following reference standards and model code documents shall be used in estimating and detailing door hardware, and shall be considered as a standard of quality, function, and performance, as applicable:
1. I.B.C. International Building Code (2009).
 2. NFPA-80 Fire Doors & Windows (2010).
 3. NFPA-101 Life Safety Code (2009).
 4. NFPA-105 Smoke Control Door Assembly. (2010)
 5. ANSI-117.1 1992 Edition Providing Accessibility and Usability for Physically Handicapped People.
 6. A.D.A.A.G Americans with Disabilities Act Accessibility Guidelines.
 - 7.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Other Action Submittals:
1. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - a. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.

- b. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule." Double space entries, and number and date each page.
 - c. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
 - d. Content: Include the following information:
 - 1) Identification number, location, hand, fire rating, size, and material of each door and frame.
 - 2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
 - 3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
 - 4) Fastenings and other pertinent information.
 - 5) Explanation of abbreviations, symbols, and codes contained in schedule.
 - 6) Mounting locations for door hardware.
 - 7) List of related door devices specified in other Sections for each door and frame.
2. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Architectural Hardware Consultant.
- B. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.
- C. Warranty: Special warranty specified in this Section.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.

1.7 QUALITY ASSURANCE

- A. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as follows:
 - 1. For door hardware, an Architectural Hardware Consultant (AHC).
- B. Source Limitations: Obtain each type of door hardware from a single manufacturer.
- C. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware rated for use in 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 or UL 10C, unless otherwise indicated.

- D. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meet requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at the tested pressure differential of 0.3-inch wg (75 Pa) of water.
- E. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- F. Accessibility Requirements: For door hardware on doors in an accessible route, comply with [the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines.
1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22.2 N).
 2. Comply with the following maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
 - b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
 4. Adjust door closer sweep periods so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.
- G. Keying Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." In addition to Contracting Officer, Contractor, and Architect, conference participants shall also include Installer's Architectural Hardware Consultant. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:
1. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 2. Preliminary key system schematic diagram.
 3. Requirements for key control system.
 4. Requirements for access control.
 5. Address for delivery of keys.
- H. Preinstallation Conference: Conduct conference at Project site.
1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 2. Inspect and discuss preparatory work performed by other trades.
 3. Review sequence of operation for each type of electrified door hardware.
 4. Review required testing, inspecting, and certifying procedures.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
- C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.
- D. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.9 COORDINATION

- A. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including excessive deflection, cracking, or breakage.
 - b. Faulty operation of doors and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 - 2. Warranty Period: Three years from date of Substantial Completion, unless otherwise indicated.
 - a. Locks: Seven years from date of Substantial Completion.
 - b. Exit Devices: Two years from date of Substantial Completion.
 - c. Manual Closers: 10 years from date of Substantial Completion.

1.11 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door and door hardware operation. Provide parts and supplies that are the same as those used in the manufacture and installation of original products.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with requirements in this Section.
 - 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products equivalent in function and comparable in quality to named products.
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by using door hardware designations, as follows:
 - 1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.
 - 2. References to BHMA Designations: Provide products complying with these designations and requirements for description, quality, and function.

2.2 HINGES

- A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.
 - 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. IVES Hardware.
 - b. Baldwin Hardware Corporation.
 - c. Bommer Industries, Inc.

2.3 MECHANICAL LOCKS AND LATCHES

- A. Lock Functions: As indicated in door hardware schedule.
- B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
 - 1. Cylindrical locks: Minimum 3/4-inch (19-mm) latchbolt throw.
 - 2. Mortise Locks: Minimum 3/4-inch (19-mm) latchbolt throw.
- C. Lock Backset: 2-3/4 inches (70 mm), unless otherwise indicated.
- D. Lock Trim:
 - 1. Operating Device: Lever with escutcheons (Schlage Rhodes).
- E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
 - 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
- A. Bored Locks: BHMA A156.2; Grade 1; Series 4000.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Schlage Commercial Lock Division; ND Series Lock.
 - b. No Substitution, Product to match existing systems.

2.4 ELECTRONIC LOCKS AND LATCHES

- A. Lock Functions: As indicated in door hardware schedule.
- B. Electronic Cylindrical Locks: A156.13/A156.25; Grade 1. UL294 Listed.
- C. Lockset to be stand-alone powered by readily available off the shelf batteries. Device shall incorporate a proximity card reader and keypad with tricolor LED indicators that indicate activation, systems status, system error conditions, and low power conditions.
- D. Lockset shall be compatible with Owners standard of Von Duprin exit devices and Schlage Primus Cores.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Schlage Commercial Lock Division; CO-100 Series Lock.
 - b. No Substitution, Product to match existing systems.

2.5 EXIT DEVICES AND AUXILIARY ITEMS

- A. Exit Devices and Auxiliary Items: BHMA A156.3. Grade 1, and UL listed for Panic Exit and/or Fire Exit Hardware.
- B. Exit devices to incorporate a deadlatching feature for security and/or for future addition of alarm kits and/or other electrical requirements.
- C. Exit devices are to incorporate a flush and tapered end cap. Exit devices shall incorporate a fluid damper or other device that eliminates noise associated with exit device operation.
- D. Provide electrical options as scheduled.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Von Duprin; 33/99 Series.
 - b. No Substitution, Product to match existing systems.
 - c.

2.6 LOCK CYLINDERS

- A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Schlage Commercial Lock Division; Primus key system.
 - b. No Substitution, Product to match existing systems.

- B. Standard Lock Cylinders: BHMA A156.5; Grade 1; large format interchangeable core cylinders; face finished to match lockset. Cylinders to be Primus patented high security keyway, verify keyway required.
- C. Construction Cores: Provide construction cores for all locks/cylinders.

2.7 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A.
 - 1. Existing Key System: All locks/cylinders shall be keyed to existing key system. Verify type required.
 - 2. Supplier shall be responsible for coordinating with the Base Locksmith and Real Property Manager a key control system and procuring all the necessary keys and cores as required.
 - 3. Incorporate decisions made in keying conference. Manufacturers keying specialist to assist in layout and design of new keys system.
- B. Keys: Brass.
 - 1. Stamping: Permanently inscribe each key with patent number and designation determined by base locksmith and include the following notation:
 - a. Notation: "DO NOT DUPLICATE."
 - 2. Quantity: In addition to one extra key blank for each lock, provide the following:
 - a. Cylinder Change Keys: Two.
 - b. Master Keys: Five for each master key system.
 - c. Control Keys: One.
 - d. Construction Master Keys: Three.
 - e. Blank Keys: One per lock.

2.8 OPERATING TRIM

- A. Operating Trim: BHMA A156.6; brass, unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. IVES Hardware.
 - b. Rockwood Manufacturing Company.
 - c. Trimco.

2.9 ACCESSORIES FOR PAIRS OF DOORS

- A. Coordinators: BHMA A156.3; consisting of active-leaf, hold-open lever and inactive-leaf release trigger; fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release; and with internal override.
- B. Astragals: BHMA A156.22.

2.10 SURFACE CLOSERS

- A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves, cast iron body, and forged-steel main arm.
- B. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
- C. Closer cylinders, arms, adapter plates, and metal covers shall have a powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117.
- D. Closers with pressure relief valves will not be acceptable.
- E. Supplier to provide any brackets or plates required for proper Installation of door closers.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. LCN Closers; 4010/4111 Series.
 - b. No Substitution, Product to match existing systems..

2.11 THRESHOLDS

- A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Reese Enterprises, Inc.
 - b. National Guard Products.
 - c. Zero International.

2.12 METAL PROTECTIVE TRIM UNITS

- A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch- (1.3-mm-) thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. IVES Hardware .
 - b. Rockwood Manufacturing Company.
 - c. Trimco.

2.13 AUXILIARY DOOR HARDWARE

- A. Auxiliary Hardware: BHMA A156.16.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. IVES Hardware.
 - b. Rockwood Manufacturing Company.
 - c. Trimco.

2.14 FABRICATION

- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Contracting Officer.
 - 1. Manufacturer's identification is permitted on rim of lock cylinders only.
- B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.
- C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
 - 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
 - 2. Fire-Rated Applications:
 - a. Wood or Machine Screws: For the following:
 - 1) Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and frames.
 - 2) Strike plates to frames.
 - 3) Closers to doors and frames.
 - b. Steel Through Bolts: For the following unless door blocking is provided:
 - 1) Surface hinges to doors.
 - 2) Closers to doors and frames.
 - 3) Surface-mounted exit devices.
 - 3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
 - 4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."
 - 5. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.15 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
- B. Wood Doors: Comply with DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."

3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 - 2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- C. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- D. Lock Cylinders: Install construction cores to secure building and areas during construction period.
 - 1. Replace construction cores with permanent cores as indicated in keying schedule or directed by Owner.

- E. Thresholds: Set thresholds for doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."
- F. Stops: Provide wall stops for doors unless floor or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic or pose a tripping hazard.
- G. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame. Apply soffit mounted seals prior to soffit mounted hardware.
- H. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- I. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately three after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.5 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.6 DEMONSTRATION

- A. Contractor to instruct owner's personnel to adjust, operate, and maintain door hardware and door hardware finishes.

3.7 DOOR HARDWARE SCHEDULE

- A. The hardware sets listed below represent the design intent and direction of the Contracting Officer. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the Contracting Officer with corrections made prior to the bidding process.

HARDWARE GROUP NO. 01

DOOR NUMBER:

102

AD x AF

EACH TO HAVE:

Qty		Description	Catalog Number	Finish	Mfr
1	EA	CONT. HINGE	224HD	628	IVE
1	EA	ELEC EXIT DEVICE TRIM	CO-100-993R-70-KP-RHO-LD	626	SCE
1	EA	PANIC HARDWARE	CD-99-EO	626	VON
1	EA	MORTISE CYLINDER	20-059	626	SCH
1	EA	RIM HOUSING	20-079	626	SCH
3	EA	FSIC CONST. CORE	23-030-ICX		SCH
3	EA	PRIMUS CORE	20-740	626	SCH
1	EA	SURFACE CLOSER	4111 SHCUSH	689	LCN
1	EA	CUSH SHOE SUPPORT	4110-30	689	LCN
1	EA	BLADE STOP SPACER	4110-61	689	LCN
1	EA	DRIP CAP	16A	CL	NGP
1	EA	DOOR SWEEP	C627A	CL	NGP
1	EA	THRESHOLD	896V	AL	NGP
	EA	NOTE	WEATHERSTRIP BY DOOR SUPPLIER		

HARDWARE GROUP NO. 02

DOOR NUMBER:

103A

HMD x HMF

EACH TO HAVE:

Qty		Description	Catalog Number	Finish	Mfr
1	EA	CONT. HINGE	224HD	628	IVE
1	EA	DUMMY PUSH BAR	330	626	VON
1	EA	TRIM	550-DT	626	VON
1	EA	SURFACE CLOSER	4111 SHCUSH	689	LCN
1	EA	CUSH SHOE SUPPORT	4110-30	689	LCN
1	EA	BLADE STOP SPACER	4110-61	689	LCN

HARDWARE GROUP NO. 03

DOOR NUMBER:

101B 103B

HMD X HMF

EACH TO HAVE:

Qty		Description	Catalog Number	Finish	Mfr
1	EA	CONT. HINGE	224HD	628	IVE
1	EA	ELEC EXIT DEVICE	CO-100-993R-70-KP-RHO-LD	626	SCE
		TRIM			
1	EA	PANIC HARDWARE	LD-99-EO	626	VON
1	EA	FSIC CONST. CORE	23-030-ICX		SCH
1	EA	PRIMUS CORE	20-740	626	SCH
1	EA	SURFACE CLOSER	4111 SHCUSH	689	LCN
1	EA	CUSH SHOE SUPPORT	4110-30	689	LCN
1	EA	BLADE STOP SPACER	4110-61	689	LCN
1	EA	DRIP CAP	16A	CL	NGP
1	SET	SEALS	700NA	CL	NGP
1	EA	DOOR SWEEP	C627A	CL	NGP
1	EA	THRESHOLD	896V	AL	NGP

NOTE: INSTALL SEALS PRIOR TO ANY SOFFIT MOUNTED HARDWARE.

HARDWARE GROUP NO. 04

DOOR NUMBER:

113

HMD x HMF

EACH TO HAVE:

Qty		Description	Catalog Number	Finish	Mfr
6	EA	HW HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
2	EA	MANUAL FLUSH BOLT	FB457	626	IVE
1	EA	STOREROOM LOCK	ND80TD RHO	626	SCH
1	EA	PRIMUS CORE	20-740	626	SCH
1	EA	OH STOP & HOLDER	90H	630	GLY
		(INACTIVE LEAF)			
1	EA	SURFACE CLOSER	4111 SHCUSH	689	LCN
		(ACTIVE LEAF)			
2	EA	ARMOR PLATE	8400 36" X 2" LDW B4E CS	630	IVE
1	EA	DRIP CAP	16A	CL	NGP
1	SET	SEALS	700NA	CL	NGP
1	EA	STEEL ASTRAGAL	BY DOOR SUPPLIER	630	
2	EA	DOOR SWEEP	C627A	CL	NGP
1	EA	THRESHOLD	896V	AL	NGP

NOTE: INSTALL SEALS PRIOR TO ANY SOFFIT MOUNTED HARDWARE.

HARDWARE GROUP NO. 05

DOOR NUMBER:

116A 116B

WD x HMF

EACH TO HAVE:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HW HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	FIRE EXIT HARDWARE	99-L-F-996-06	626	VON
1	EA	RIM HOUSING	20-079	626	SCH
1	EA	PRIMUS CORE	20-740	626	SCH
1	EA	SURFACE CLOSER	4111 EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	FIRE/LIFE WALL MAG	SEM7850	689	LCN
1	SET	SEALS	2525B	BRN	NGP

HARDWARE GROUP NO. 06

DOOR NUMBER:

101C

HMD x HMF

EACH TO HAVE:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HW HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PANIC HARDWARE	99-L-996-06	626	VON
1	EA	RIM HOUSING	20-079	626	SCH
1	EA	PRIMUS CORE	20-740	626	SCH
1	EA	SURFACE CLOSER	4111 HEDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	SET	SEALS	2525B	BRN	NGP

HARDWARE GROUP NO. 07

DOOR NUMBER:

110

WD x HMF

EACH TO HAVE:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HW HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	ND80TD RHO	626	SCH
1	EA	PRIMUS CORE	20-740	626	SCH
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	SET	SEALS	2525B	BRN	NGP

HARDWARE GROUP NO. 08

DOOR NUMBER:

104 112

WD x HMF

EACH TO HAVE:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HW HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	ND80TD RHO	626	SCH
1	EA	PRIMUS CORE	20-740	626	SCH
1	EA	KICK PLATE	8400 10" X 2" LDW B4E CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 09

DOOR NUMBER:

115

WD x HMF

EACH TO HAVE:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HW HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	ENTRANCE LOCK	ND53TD RHO	626	SCH
1	EA	PRIMUS CORE	20-740	626	SCH
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	SET	SEALS	2525B	BRN	NGP

HARDWARE GROUP NO. 10

DOOR NUMBER:

106 107 108 111

WD x HMF

EACH TO HAVE:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HW HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PUSH PLATE	8200 4" X 16"	630	IVE
1	EA	PULL PLATE	8303 10" 4"X16"	630	IVE
1	EA	OH STOP	90S	630	GLY
			(AT DOOR 107)		
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	SET	SEALS	2525B	BRN	NGP

HARDWARE GROUP NO. 11

DOOR NUMBER:

101A

OVERHEAD DOOR

EACH TO HAVE:

Qty		Description	Catalog Number	Finish	Mfr
1	EA	MORTISE CYLINDER	20-059	626	SCH
1	EA	PRIMUS CORE	20-740	626	SCH
	EA	NOTE	REMAINDER OF HARDWARE BY DOOR SUPPLIER		

END OF SECTION 087100

SECTION 08 8000 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Windows.
 - 2. Doors.
 - 3. Storefront framing.
 - 4. Glazed entrances.
 - 5. Interior borrowed lites.

1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. Interspace: Space between lites of an insulating-glass unit.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Delegated Design: Design glass, including comprehensive engineering analysis according to ICC's 2003 International Building Code by a qualified professional engineer, using the following design criteria:
 - 1. Design Wind Pressures: As indicated on Drawings, Sheet S001
 - 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.
 - 4. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

C. Structural Loads:

1. Blast Loads: Designed to meet UFC 4-010-01, dated February 9, 2013 including Change 1, dated October 1, 2013 with Applicable Explosive Wt. I.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

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

1.5 SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.

1. Laminated glass with colored interlayer.
2. Insulating glass.

C. Glazing Accessory Samples: For gaskets, in 12-inch (300-mm) lengths. Install sealant Samples between two strips of material representative in color of the adjoining framing system.

D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

E. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

F. Qualification Data: For installers.

G. Product Certificates: For glass and glazing products, from manufacturer.

H. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for glazing gaskets.

1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

I. LEED Submittals:

1. Recycled Content – Credit MR 4.2: Provide documentation indicating percentages of post-consumer and pre-consumer recycled content by weight per unit of product or assembly containing the product. Indicate the percentage of the dollar of the recycled content compared to the total dollar value of the product or assembly containing the product.
2. Regional Materials – Credit MR 5.2: Where the distance to the Project site is 500 miles or less, indicate location and distance to the Project site of extraction, harvesting, recovery and manufacturing of all materials. Indicate the dollar value of the material cost of the product containing local/regional materials. Where product components are sourced or manufactured in separate locations, provide location and percentage by weight of each component per unit of product.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.
- B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- C. Source Limitations for Glass: Obtain tinted float glass, coated float glass, laminated glass, and insulating glass from single source from single manufacturer for each glass type.
- D. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.
- E. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: GANA's "Laminated Glazing Reference Manual" and GANA's "Glazing Manual."
 - 2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- F. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or the manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- G. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F (4.4 deg C).

1.9 WARRANTY

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

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. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.
- B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass 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.
- C. 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.
4. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.2 GLASS PRODUCTS

- A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
- B. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.
 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
 2. For uncoated glass, comply with requirements for Condition A.
 3. For coated vision glass, comply with requirements for Condition C (other coated glass).

2.3 LAMINATED GLASS

- A. Laminated Glass: ASTM C 1172, and complying with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
 1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written recommendations.
 2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
 3. Interlayer Color: Clear unless otherwise indicated.
- B. Glass: Comply with applicable requirements in "Glass Products" Article as indicated by designations in "Laminated-Glass Types" Article.

2.4 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.
 1. Sealing System: Dual seal, with manufacturer's standard primary and secondary.
 2. Spacer: Manufacturer's standard spacer material and construction.
- B. Glass: Comply with applicable requirements in "Glass Products" Article and in "Laminated Glass" Article as indicated by designations in "Insulating-Glass Types" Article and in "Insulating-Laminated-Glass Types" Article.

2.5 GLAZING GASKETS

- A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:

1. Neoprene complying with ASTM C 864.
2. EPDM complying with ASTM C 864.
3. Silicone complying with ASTM C 1115.
4. Thermoplastic polyolefin rubber complying with ASTM C 1115.

2.6 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.7 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

2.8 MONOLITHIC-GLASS

- A. Clear fully tempered float glass.
 1. Thickness:
 - a. Typical: 1/4- inch (6.35 mm).
 2. Provide safety glazing labeling.

2.9 LAMINATED-GLASS

- A. Clear laminated glass with two plies of annealed float glass.
 1. Thickness of Each Glass Ply: 1/8-inch (3.35 mm).
 2. Interlayer Thickness: 0.090 inch (2.29 mm).
 3. Provide safety glazing labeling.

2.10 INSULATING-GLASS

- A. Clear insulating glass.
1. Overall Unit Thickness: 1 inch (25 mm).
 2. Thickness of Each Glass Lite: 1/4-inch (6.35 mm).
 3. Outdoor Lite: Clear annealed or fully tempered float glass as noted on drawings.
 4. Interspace Content: Air.
 5. Indoor Lite: Clear annealed, laminated float glass.
 6. Low-E Coating: Pyrolytic on surface #3.
 7. Transmittance:
 - a. Visible Light: 62 percent.
 - b. Solar Energy: 33 percent.
 - c. UV: 10 percent.
 8. Reflectance:
 - a. Visible Light – Exterior: 11 percent.
 - b. Visible Light – Interior: 12 percent.
 - c. Solar Energy: 31 percent.
 9. U-Value:
 - a. Winter Nighttime: 0.29 Btu/(hr. x sq. ft. x deg. F).
 - b. Summer Daytime: 0.26 Btu/(hr. x sq. ft. x deg. F).
 10. Shading Coefficient: 0.35.
 11. Relative Heat Gain: 91 Btu/hf x sq. ft.
 12. Solar Factor (SHGC): 0.3045.
 13. LSG: 1.85.
 14. Provide safety glazing labeling.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 2. Presence and functioning of weep systems.
 3. Minimum required face and edge clearances.
 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- L. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 GASKET GLAZING (DRY)

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

3.5 CLEANING AND PROTECTION

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

END OF SECTION 08 8000

SECTION 09 2216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
2. Wind loaded steel framing systems for exterior wall panels.
3. Suspension systems for interior gypsum ceilings, soffits, and grid systems.

- B. Related Requirements:

1. Division 05 Section "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; roof rafters and ceiling joists; and roof trusses.

1.3 ACTION SUBMITTALS

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

- B. LEED Submittals:

1. Recycled Content – Credit MR 4.2: Provide documentation indicating percentages of post-consumer and pre-consumer recycled content by weight per unit of product or assembly containing the product. Indicate the percentage of the dollar of the recycled content compared to the total dollar value of the product or assembly containing the product.
2. Regional Materials – Credit MR 5.2: Where the distance to the Project site is 500 miles or less, indicate location and distance to the Project site of extraction, harvesting, recovery and manufacturing of all materials. Indicate the dollar value of the material cost of the product containing local/regional materials. Where product components are sourced or manufactured in separate locations, provide location and percentage by weight of each component per unit of product.

PART 2 - PRODUCTS

2.1 FRAMING SYSTEMS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

- B. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
 2. Protective Coating: ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized. G90 (Z275) hot dip galvanized at shower ceilings.
- C. Studs and Runners: ASTM C 645. Use either steel studs and runners or dimpled steel studs and runners.
1. Steel Studs and Runners (General):
 - a. Minimum Base-Metal Thickness: 0.018 inch (0.45 mm).
 - b. Depth: As indicated on Drawings.
 2. Steel Studs and Runners (Exterior Wall):
 - a. Minimum Base-Metal Thickness: 0.045 inch (1.2 mm).
 - b. Depth: 6 inches
 3. Dimpled Steel Studs and Runners:
 - a. Minimum Base-Metal Thickness: 0.015 inch (0.38 mm).
 - b. Depth: As indicated on Drawings.
- D. Slip-Type Head Joints: Where indicated, provide one of the following:
1. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
 2. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Dietrich Metal Framing; SLP-TRK Slotted Deflection Track.
 - 2) Steel Network Inc. (The); VertiClip SLD Series.
 - 3) Superior Metal Trim; Superior Flex Track System (SFT).
- E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. Minimum Base-Metal Thickness: 0.018 inch (0.45 mm).
- F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
1. Minimum Base-Metal Thickness: 0.018 inch (0.45 mm).
 2. Depth: As indicated on Drawings.
- G. Resilient Furring Channels: 1/2-inch- (13-mm-) deep, steel sheet members designed to reduce sound transmission.
1. Configuration: Hat shaped.

- H. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
 - 1. Depth: As indicated on Drawings.
 - 2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch (0.8 mm).
 - 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.
- I. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (32 mm), wall attachment flange of 7/8 inch (22 mm), minimum uncoated-metal thickness of 0.018 inch (0.45 mm), and depth required to fit insulation thickness indicated.

2.2 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.
- B. Hanger Attachments to Concrete:
 - 1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.
 - a. Type: Postinstalled, chemical anchor.
 - 2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.
- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.
- D. Flat Hangers: Steel sheet, 1 by 3/16 inch (25 by 5 mm) by length indicated.
- E. Furring Channels (Furring Members):
 - 1. Cold-Rolled Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 7/8 inch deep.
 - 2. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22 mm) deep.
 - a. Minimum Base-Metal Thickness: 0.0312 inch.
 - 3. Resilient Furring Channels: 1/2-inch- (13-mm-) deep members designed to reduce sound transmission.
 - a. Configuration: Hat shaped.

- F. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
 - 1. Protective Coating: ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized. G90 (Z275) hot dip galvanized at shower ceilings.
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Armstrong World Industries, Inc.; Drywall Grid Systems.
 - b. Chicago Metallic Corporation; Drywall Grid System.
 - c. USG Corporation; Drywall Suspension System.

2.3 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 - 1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide one of the following:
 - 1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
 - 2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
 - 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
 - 1. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.
 - 2. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- C. Install bracing at terminations in assemblies.
- D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 - 1. Single-Layer Application: 16 inches (406 mm) o.c. unless otherwise indicated.
 - 2. Multilayer Application: 16 inches (406 mm) o.c. unless otherwise indicated.
 - 3. Tile Backing Panels: 16 inches (406 mm) o.c. unless otherwise indicated.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
 - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
- E. Z-Furring Members:

1. Erect insulation, specified in Division 07 Section "Thermal Insulation," vertically and hold in place with Z-furring members spaced 24 inches (610 mm) o.c.
 2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
 3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (305 mm) from corner and cut insulation to fit.
- F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.5 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 5. Do not attach hangers to steel roof deck.
 6. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 7. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
- E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

- F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 mm) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 09 2216

SECTION 09 2900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Interior gypsum board.

- B. Related Requirements:

- 1. Division 09 Section "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board panels.

1.3 ACTION SUBMITTALS

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

- B. LEED Submittals:

- 1. Recycled Content – Credit MR 4.2: Provide documentation indicating percentages of post-consumer and pre-consumer recycled content by weight per unit of product or assembly containing the product. Indicate the percentage of the dollar of the recycled content compared to the total dollar value of the product or assembly containing the product.
 - 2. Regional Materials – Credit MR 5.2: Where the distance to the Project site is 500 miles or less, indicate location and distance to the Project site of extraction, harvesting, recovery and manufacturing of all materials. Indicate the dollar value of the material cost of the product containing local/regional materials. Where product components are sourced or manufactured in separate locations, provide location and percentage by weight of each component per unit of product.
 - 3. Product Data for Credit IEQ 4.1: For adhesives used to laminate gypsum board panels to substrates, documentation including printed statement of VOC content.

- C. Samples: For the following products:

- 1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.2 GYPSUM BOARD, GENERAL

- A. Recycled Content of Gypsum Panel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 20 percent.
- B. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Gypsum.
 - 2. Georgia-Pacific Gypsum LLC.
 - 3. USG Corporation.
- B. Gypsum Wallboard: ASTM C 1396/C 1396M.
 - 1. Thickness: 5/8 inch (15.9 mm).
 - 2. Long Edges: Tapered and featured (rounded or beveled) for prefilling
- C. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.
 - 1. Core: 5/8 inch (15.9 mm), regular type.
 - 2. Long Edges: Tapered and featured (rounded or beveled) for prefilling. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.4 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
 - 1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, or paper-faced galvanized steel sheet.
 - 2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. L-Bead: L-shaped; exposed long flange receives joint compound.
 - d. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - e. Expansion (control) joint.

2.5 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.
- C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 - 3. Fill Coat: For second coat, use setting-type, sandable topping compound.
 - 4. Finish Coat: For third coat, use setting-type, sandable topping compound.

2.6 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
 - 1. Laminating adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
 - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

- D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - 1. Recycled Content of Blankets: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 20 percent.
- E. Sound Attenuation Blankets: ASTM C 665, Type III (blankets with reflective facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool, with aluminum foil kraft facing one side.
 - 1. Recycled Content of Blankets: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 20 percent.
- F. 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.
- G. Thermal Insulation: As specified in Division 07 Section "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.

- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- J. Install sound attenuation blankets where scheduled. Apply foil faced tape at joints of foil faced blanket locations. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Wallboard Type: Vertical surfaces unless otherwise indicated.
 - 2. Ceiling Board Type: Horizontal surfaces unless otherwise indicated.
 - 3. Moisture Resistant Type: Walls with plumbing fixture piping penetrations and shower ceilings.
- B. Single-Layer Application:
 - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
 - 2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
 - 3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
 - 4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches (400 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
3. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

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 at locations indicated on Drawings and according to ASTM C 840 and in specific locations approved by Contracting Officer 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. L-Bead: Use where indicated.
 4. U-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, rounded or beveled edges, and damaged surface areas.
 1. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape. Apply foil faced joint tape at foil backed gypsum board locations.
- C. 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 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.

3.6 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 2900

SECTION 09 3000 - TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Ceramic tile.
- 2. Metal edge strips

- B. Related Sections:

- 1. Division 07 Section "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.

1.3 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.5, ANSI A108.10, and ANSI A108.17, which are contained in "American National Standard Specifications for Installation of Ceramic Tile."
- C. Module Size: Actual tile size plus joint width indicated.
- D. Face Size: Actual tile size, excluding spacer lugs.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- C. Samples for Verification:
 - 1. Full-size units of each type and composition of tile and for each color and finish required.
 - 2. Metal edge strips in 6-inch (150-mm) lengths.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.
- C. Product Certificates: For each type of product, signed by product manufacturer.
- D. Material Test Reports: For each tile-setting and -grouting product.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
 - 2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.7 QUALITY ASSURANCE

- A. Source Limitations for Tile: Obtain tile of each type and color or finish from one source or producer.
 - 1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one manufacturer and each aggregate from one source or producer.
- C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer for each product:
 - 1. Joint sealants.
 - 2. Metal edge strips.
- D. Preinstallation Conference: Conduct conference at location determined by Contracting Officer.
 - 1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.
- E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

1.10 EXTRA MATERIALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Tile: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
 - 2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
 - 1. Provide tile complying with Standard grade requirements unless otherwise indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCA installation methods specified in tile installation schedules, and other requirements specified.
- C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.
- D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.
 - 1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

- E. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.2 TILE PRODUCTS

A. Glazed porcelain tile.

- 1. Manufacturers: Subject to compliance with requirements, provide, or comparable American made product if approved by Contracting Officer prior to bidding.
 - a. American Olean, Division of Dal-Tile International Inc.
 - b. Dal-Tile International Inc. Division of Dal-Tile International Inc.
 - c. United States Ceramic Tile Compant
- 2. Product: Glazed Wall tile. Standard grade conforming to ANSI A137.1, porcelain type, glazed face, with cushion edges, factory back-mounted.
 - a. Composition: Glazed face with cushion edges.
 - b. Module Size: 6 by 6 inches
 - c. Thickness: 1/4 inch
 - d. Special Shapes:
 - 1) Bullnose
 - 2) Bullnose corner
 - 3)
 - e. Surface: Glazed finish. Gloss and satin finish
 - f. Tile Color: As selected by Contracting Officer from manufacturer's full range.
 - g. Grout Color: As selected by Contracting Officer from manufacturer's full range.
 - h. Grout Size: 3/32"
 - i. Allow for 2 colors from Price group 2 and once color from price group 3

2.3 SETTING MATERIALS

A. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.

- 1. Manufacturers: Subject to compliance with requirements, provide product by one of the following:
 - a. Bonsal American; an Oldcastle company.
 - b. C-Cure.
 - c. Custom Building Products.
 - d. Laticrete International, Inc.
 - e. MAPEI Corporation.
 - f. TEC; a subsidiary of H. B. Fuller Company.
- 2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
- 3. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

2.4 GROUT MATERIALS

A. Modified Tile Grout: ANSI A118.3.

1. Manufacturers: Subject to compliance with requirements, provide product from one of the following manufacturers:
 - a. Bostik.; TruColor, pre-mixed grout (Basis of Design).
 - b. Laticrete International, Inc., Quartzlock
 - c. MAPEI Corporation.
 - d. TEC; a subsidiary of H. B. Fuller Company.
2. Type: Water-based, urethane grout.
3. Product shall contain integral grout sealer.

2.5 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Metal Edge Strips:
 1. Edge-Protection Profile for Walls:
 - a. Schuluter-Jolly
 - 1) 3/8" profile
 - 2) Satin anodized aluminum
- C. Temporary Protective Coating: Product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.
 1. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.
- D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

2.6 WATERPROOFING MEMBRANE

- A. Polyethylene membrane, 0.008 inch (0.2 mm) thick, with polypropylene fleece laminated on both sides, which meets or exceeds the requirements of the "American national standard specifications for load bearing, bonded, waterproof membranes for thin-set ceramic tile and dimension stone installation A118.10," and is listed by cUPC®, and is evaluated by ICC-ES.
 1. Schuluter-KERDI
 2. Install in shower area.

2.7 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
 - 1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
 - 2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
 - 3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Contracting Officer.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.
- C. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 TILE INSTALLATION

- A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
 - 1. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
 - 2. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
- E. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 - 1. Ceramic Wall Tile: 3/32 inch
- F. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- G. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
 - 1. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

3.4 CLEANING AND PROTECTING

- A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - 1. Remove grout residue from tile as soon as possible.
 - 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
 - 3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.
- B. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- D. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

END OF SECTION 09 3000

SECTION 09 5113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes acoustical panels and exposed suspension systems for ceilings.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.
 - 2. Product Data for Credit EQ 4.1: For sealants, documentation including printed statement of VOC content.
 - 3. Laboratory Test Reports for Credit EQ 4: For sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 - 4. Regional Materials – Credit MR 5.2: Where the distance to the Project site is 500 miles or less, indicate location and distance to the Project site of extraction, harvesting, recovery and manufacturing of all materials. Indicate the dollar value of the material cost of the product containing local/regional materials. Where product components are sourced or manufactured in separate locations, provide location and percentage by weight of each component per unit of product.
- C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
 - 1. Acoustical Panel: Set of 6-inch- (150-mm-) square Samples of each type, color, pattern, and texture.
 - 2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch- (150-mm-) long Samples of each type, finish, and color.

1.4 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:
 - 1. Suspended ceiling components.

2. Structural members to which suspension systems will be attached.
3. Size and location of initial access modules for acoustical panels.
4. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. AV equipment.
5. Perimeter moldings.

B. Qualification Data: For testing agency.

C. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.

D. Evaluation Reports: For each acoustical panel ceiling suspension system, from ICC-ES.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

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

1. Acoustical Ceiling Panels: Full-size panels equal to 2 percent of quantity installed.
2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.
3. Hold-Down Clips: Equal to 2 percent of quantity installed.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to NVLAP for testing indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Acoustical ceiling and clouds shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. Seismic Design Criteria for building and components: Refer to Structural Drawing Sheet S1.00 for Seismic Design Criteria.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
 - 2. Smoke-Developed Index: 50 or less.

2.2 ACOUSTICAL PANELS, GENERAL

- A. Source Limitations:
 - 1. Acoustical Ceiling Panel: Obtain each type from single source from single manufacturer.
 - 2. Suspension System: Obtain each type from single source from single manufacturer.
- B. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system from single source from single manufacturer.
- C. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 40 percent.
- D. Glass-Fiber-Based Panels: Made with binder containing no urea formaldehyde.
- E. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.
 - 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface according to ASTM E 795.
- F. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
 - 1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Contracting Officer from each manufacturer's

full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.3 ACOUSTICAL PANELS "AC-1"

- A. Manufacturer: Subject to compliance with requirements, provide product by one of the following:
1. Armstrong, (Basis of Design)
 2. Chicago Metallic Corporation.
 3. USG Interiors, Inc.; Subsidiary of USG Corporation.
 4. Decoustics.
- B. Product: Armstrong, Fine Fissured #755.
- C. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:
1. Type and Form: Type III, mineral base with painted finish; Form 2, nodular.
 2. Pattern: CE (perforated, small holes and lightly textured).
- D. Color: White.
- E. LR: Not less than 0.81.
- F. NRC: Not less than 0.55.
- G. CAC: Not less than 30.
- H. AC: Not less than 150.
- I. Edge/Joint Detail: Square.
- J. Thickness: 5/8 inch (15 mm).
- K. Modular Size: 24 by 48 inches (610 by 1,200 mm).
- L. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.
- M. Grid: Prelude 15/16" XL, Color white.

2.4 METAL SUSPENSION SYSTEMS, GENERAL

- A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.

1. High-Humidity Finish: Comply with ASTM C 635/C 635M requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.
- C. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
 3. Nickel-Copper-Alloy Wire: ASTM B 164, nickel-copper-alloy UNS No. N04400.
 4. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.135-inch- (3.5-mm-) diameter wire.
- D. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- E. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide; formed with 0.04-inch- (1-mm-) thick, galvanized-steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch- (8-mm-) diameter bolts.
- F. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
- G. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
- H. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in place.
- I. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches (610 mm) o.c. on all cross tees. Reference manufacturer's recommendations for "Metalworks, and curved ceiling systems. Required where recommended by manufacturer.

2.5 METAL SUSPENSION SYSTEM

- A. Manufacturer: Subject to compliance with requirements, provide product by one of the following:
1. Armstrong, (Basis of Design).
 2. Chicago Metallic Corporation.
 3. USG Interiors, Inc.; Subsidiary of USG Corporation.
 4. Decoustics.
- B. Product: Armstrong 15/16" Standard Prelude XL
- C. Wide-Face, Capped, Double-Web, Hot-Dip Galvanized, G60 (Z180), Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; hot-dip galvanized according to ASTM A 653/A 653M, G60 (Z180) coating designation; with prefinished, cold-rolled, 15/16-inch- (24-mm-) wide aluminum caps on flanges.
1. Structural Classification: Heavy-duty system.
 2. Seismic RX Suspension System.
 3. Face Design: Flat, flush.
 4. Face Finish: Painted white.

2.6 METAL SUSPENSION SYSTEM

- A. Manufacturer: Subject to compliance with requirements, provide product by one of the following:
1. Armstrong, (Basis of Design).
 2. Chicago Metallic Corporation.
 3. USG Interiors, Inc.; Subsidiary of USG Corporation.
 4. Decoustics.
- B. Product: Armstrong 15/16" Standard Prelude XL.
- C. Wide-Face, Capped, Double-Web, Hot-Dip Galvanized, G60 (Z180), Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; hot-dip galvanized according to ASTM A 653/A 653M, G60 (Z180) coating designation; with prefinished, cold-rolled, 15/16-inch- (24-mm-) wide aluminum caps on flanges.
1. Structural Classification: Heavy-duty system.
 2. Seismic RX Suspension System.
 3. Face Design: Flat, flush.
 4. Factory Face Finish:
 - a. White
 - b. Tech Black where noted.

2.7 METAL SUSPENSION SYSTEM

- A. Manufacturer: Subject to compliance with requirements, provide product by one of the following:
1. Armstrong, (Basis of Design).
 2. Chicago Metallic Corporation.
 3. USG Interiors, Inc.; Subsidiary of USG Corporation.
 4. Decoustics.
- B. Product: Armstrong 15/16" Standard Prelude XL – Humi-Guard Plus.
- C. Wide-Face, Capped, Double-Web, Hot-Dip Galvanized, G60 (Z180), Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; hot-dip galvanized according to ASTM A 653/A 653M, G60 (Z180) coating designation; with prefinished, cold-rolled, 15/16-inch- (24-mm-) wide aluminum caps on flanges.
1. Structural Classification: Heavy-duty system.
 2. Seismic RX Suspension System.
 3. Face Design: Flat, flush.
 4. Face Finish: Factory Painted White.
 5. Humi-Guard Plus.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified

in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook." and "Guidelines for Seismic Restraint for Direct Hung Suspended Ceiling Assemblies, Seismic Zones 3 and 4".
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 - 4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 - 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 - 6. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 - 7. Do not attach hangers to steel deck tabs.
 - 8. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 - 9. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
 - 10. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
 - 11. Use manufacturer installation guidelines for panels designated to be installed on a slope.

- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
 - 1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 - 2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.
 - 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- D. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- E. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
 - 1. Arrange directionally patterned acoustical panels as follows:
 - a. As indicated on reflected ceiling plans.
 - 2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
 - 3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 - 4. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

3.4 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 5113

SECTION 09 6519 - RESILIENT TILE FLOORING AND BASE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 1. Vinyl Composition floor tile
 2. Resilient base and accessories

1.3 ACTION SUBMITTALS

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

1.4 LEED Submittals:

1. Product Data for Credit IEQ 4.3: For resilient tile flooring, documentation from an independent testing agency indicating compliance with the FloorScore Standard.
2. Regional Materials – Credit MR 5.2: Where the distance to the Project site is 500 miles or less, indicate location and distance to the Project site of extraction, harvesting, recovery and manufacturing of all materials. Indicate the dollar value of the material cost of the product containing local/regional materials. Where product components are sourced or manufactured in separate locations, provide location and percentage by weight of each component per unit of product.
3. Recycled Content – Credit MR 4.2: Provide documentation indicating percentages of post-consumer and pre-consumer recycled content by weight per unit of product or assembly containing the product. Indicate the percentage of the dollar of the recycled content compared to the total dollar value of the product or assembly containing the product.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
 2. Static coefficient of friction: ASTM D 2047 >0.6
 3. Static Load Limit: ASTM F 970 – 250 psi

1.7 MATERIALS MAINTENANCE SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents
 - 1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.
 - 2. Furnish not less than one box for each 50 boxes or fraction thereof, of each type, color, patten, class, wearing surface and size of resilient tile flooring installed.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store floor tiles on flat surfaces.

1.9 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 85 deg F (29 deg C) in spaces to receive floor tile during the following time periods:
 - 1. 72 hours before installation for tile, 48 hours for wall base.
 - 2. During installation.
 - 3. 72 hours after installation for tile, 48 hours for wall base.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 72 hours after floor tile installation.
- E. Install floor tile and resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 VINYL COMPOSITION FLOOR TILE

- A. Products: Subject to compliance with requirements, provide product from one f the following:
 - 1. Johnsonite.
 - 2. Armstrong World Industries.
 - 3. Tarkett, Inc.
- B. Tile Standard: ASTM F 1066.
 - 1. Class: Class II, through-pattern vinyl tile.
 - 2. Type: smooth surface.
- C. Thickness: .125 inches

- D. Size: 12 by 12 inches.
- E. Colors and Patterns: Reference Floor Finish sheets for field and accent colors. Up to three colors.
 - 1. Provide twelve inch border around Hall 103 perimeter of contrasting color.

2.2 RESILIENT BASE

- A. Resilient Base:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Mannington Commercial
 - b. Roppe Corporation, USA. (Basis of Design)
 - c. Johnsonite
- B. Resilient Base Standard: ASTM F 1861.
 - 1. Material Requirement: Type TS (rubber, vulcanized thermoset).
 - 2. Manufacturing Method: Group I (solid, homogeneous).
 - 3. Style: Cove (base with toe).
 - 4. Minimum Thickness: 0.125 inch.
 - 5. Height: 4 inches
 - 6. Lengths: Coils in manufacturer's standard length only. Four foot strips will not be accepted.
 - 7. Outside Corners: Job formed.
 - 8. Inside Corners: Job formed.
 - 9. Colors and Patterns: Black Brown.

2.3 RESILIENT MOLDING ACCESSORY

- A. Resilient Molding Accessory
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johnsonite
 - b. Roppe Corporation, USA.
- B. Transition Strip
 - 1. Description: Carpet edge for glue-down applications Nosing for carpet Nosing for resilient floor covering Joiner for tile and carpet Transition strips.
 - 2. Material: Rubber.
 - 3. Profile and Dimensions: As required for smooth transitions. Provide appropriate transition at each surface change.
 - 4. Color and Patterns: As selected by Contracting Officer from full range of industry colors.

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 resilient products and substrate conditions indicated.

1. Adhesives shall have a VOC content of 50g/L or less when calculated according to 40 CFR 59, subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
 4. Moisture Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor tiles or resilient products until they are same temperature as space where they are to be installed.
 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles square with room axis. Unless indicated otherwise on plan,
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
1. Lay tiles with grain direction alternating in adjacent tiles (basket-weave pattern).
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.
- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- H. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
1. Adhesive for Semi-permanent installation, Johnsonite #905
 2. Flooring must be installed while adhesive is wet. Roll the floor covering with a 100lb. three-section roller to break down adhesive ridges and expel any entrapped air while adhesive is still wet. Avoid working on newly installed flooring whenever possible.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of floor tile and resilient products.
- B. Perform the following operations immediately after completing floor tile installation and resilient product:
1. Remove adhesive and other blemishes from exposed surfaces.
 2. Sweep and vacuum surfaces thoroughly.
 3. Damp-mop surfaces to remove marks and soil.
- C. Protect floor tile and resilient products from marks, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Product is No Wax, No Polish Tile.
- E. Cover floor tile and resilient products until Final Completion.

3.5 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base 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. Minimum length to be 18".
- D. Tightly adhered 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. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible form without producing discoloration (whitening) at bends.
 - 2. Inside Corners: Use straight pieces of maximum lengths possible.

3.6 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer stripes at edges of (carpet) (resilient floor covering) that would otherwise be exposed.

END OF SECTION 09 6519

SECTION 09 6723 - RESINOUS FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Decorative resinous flooring and wall coating system.

- B. Related Sections:

- 1. Section 079200 "Joint Sealants" for sealants installed at joints in resinous flooring systems.
 - 2. Section 096600 "High Performance Coatings" for specialty coatings on wall and ceiling in wet areas.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.

- B. LEED Submittals:

- 1. Product Data for Credit IEQ 4.2: For liquid-applied flooring and wall coating components, documentation including printed statement of VOC content.
 - 2. Laboratory Test Reports for Credit IEQ 4: For flooring and wall coating systems, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- C. Samples for Initial Selection: For each type of exposed finish required.

- D. Samples for Verification: For each resinous flooring and wall coating system required, provide a 6 inch (150 mm) square, applied to a rigid backing by Installer for this Project.

- E. Product Schedule: For resinous flooring and wall coating system. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.

- B. Material Certificates: For each resinous flooring and wall coating component, from manufacturer.
- C. Material Test Reports: For each resinous flooring and wall coating system.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of flooring systems required for this Project.
 - 1. Engage an installer who is certified in writing by resinous flooring and wall coating manufacturer as qualified to apply resinous flooring systems indicated.
 - 2. Surfacing shall be applied by a surfacing applicator approved by the Contracting Officer, with a minimum of seven (7) years experience installing the brand of surfacing in similar size projects. A list of ten (10) completed projects using the specified materials must be submitted proving seven (7) years experience by the lead installer.
- B. Source Limitations: Obtain primary resinous flooring and wall coating system materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.
- C. Preinstallation Conference: Conduct conference at Project site.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

1.8 PROJECT CONDITIONS

- A. Work on seamless flooring and wall coating shall not commence until the building can be maintained at a minimum temperature of 55°F for 48 hours before, during and 48 hours after application. Areas shall also be broom clean and reasonably dust free and shall have adequately controlled ventilation with bright, uniform lighting.
- B. Environmental Limitations: Comply with resinous flooring and wall coating manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
- C. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring and wall coating application.

- D. Close spaces to traffic during resinous flooring and wall coating application and for not less than 24 hours after application unless manufacturer recommends a longer period.
- E. Surfaces shall be acceptable in accordance with flooring and wall coating manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Desco Coatings, Inc. (Basis of design)
 - 2. Tennant Floor Coatings
 - 3. Tnemec Company, Inc.

2.2 MATERIALS

- A. VOC Content of Liquid-Applied Flooring and wall coating Components: Not more than 100 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
- B. Low-Emitting Materials: Flooring and wall coating system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers.
- C. Moisture Vapor Barrier: Placement of on-grade slabs over a Class A vapor retarder as defined by ASTM E-145 and per Manufacturer's recommendations.

2.3 DECORATIVE RESINOUS FLOORING COATING

- A. Resinous Flooring: Abrasion, impact and chemical-resistant, decorative-aggregate-filled, epoxy-resin-based, monolithic floor surfacing designed to produce a seamless floor and integral cove base.
- B. System Characteristics:
 - 1. Color and Pattern: Desco Quartz Cremona TG Series, color as selected by Contracting Officer from manufacturer's full range.
 - 2. Floor Wearing Surface:
 - a. At typical non-wet areas: Stipple finish with no aggregate.
 - b. At Showers and adjacent drying areas: add aluminum oxide for medium texture.
 - 3. Overall System Thickness: 3/16 inch (4.8 mm).
 - 4. Federal Agency Approvals: FDA approved for food-processing environments.
- C. Body Coat:
 - 1. Resin: Epoxy.

2. Formulation Description: 100 percent solids clear/epoxy resin.
 3. Application Method: Troweled or screeded.
 - a. Thickness of Coats: 3/16 inch (4.8 mm) over epoxy primer.
 - b. Number of body Coats over primer: One.
 4. Aggregates: Colored quartz (ceramic-coated silica).
- D. Topcoat: Sealing or finish coats.
1. Resin: Epoxy.
 2. Formulation Description: 100 percent solids.
 3. Type: Clear.
 4. Finish: Semi-Gloss.
 5. Number of Coats: One.
- E. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:
1. Compressive Strength: 10,700-11,000 per ASTM C 579.
 2. Tensile Strength: 2,250 psi per ASTM C 307.
 3. Flexural Modulus of Elasticity: 4,000 psi per ASTM C 580.
 4. Impact Resistance: No chipping, cracking, or delamination and not more than 1/16-inch (1.6-mm) permanent indentation per MIL-D-3134.
 5. Resistance to Elevated Temperature: No slip or flow of more than 1/16 inch (1.6 mm) per MIL-D-3134.
 6. Abrasion Resistance: 0.08gm maximum weight loss per ASTM D 4060.
 7. Flammability: Self-extinguishing per ASTM D 635.
 8. Hardness: 85-90 Shore D per ASTM D 2240.
 9. Bond Strength: 425 psi, 100 percent concrete failure per ACI 503R.
 10. Epoxy top coat shall have no color shift after exposure to fluorescent lighting on the "b" axis yellow index after 3 weeks exposure.

2.4 ACCESSORIES

- A. Primer: Type recommended by manufacturer for substrate and body coats indicated.
1. Formulation Description: 100 percent solids.
- B. Waterproofing Membrane: Type recommended by manufacturer for substrate and primer and body coats indicated.
1. Formulation Description: 100 percent solids.
- C. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.
- B. Concrete Slab-On-Grade Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
 - 1. Roughen concrete slab-on-grade substrates as follows:
 - a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
 - b. Comply with ASTM C 811 requirements unless manufacturer's written instructions are more stringent. Acid etching is not acceptable.
 - 2. Repair damaged and deteriorated concrete according to resinous flooring and wall coating manufacturer's written instructions.
 - 3. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
 - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application of resinous flooring only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) of slab area in 24 hours.
 - b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
 - 4. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.
- C. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.
- D. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
- E. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring and wall coating according to manufacturer's written instructions.

3.2 APPLICATION

- A. General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
 - 1. Coordinate application of components to provide optimum adhesion of resinous flooring and wall coating system to substrate, and optimum intercoat adhesion.

2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
 3. At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.
- B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Apply waterproofing membrane at flooring locations, in manufacturer's recommended thickness.
1. Apply waterproofing membrane to integral cove base substrates.
- D. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.
1. Integral Cove Base: 6 inches (100 mm) high with 1" radius cove where indicated on drawings.
- E. Apply troweled or screeded body coats in thickness indicated for flooring locations. Apply troweled body coats in thickness indicated for wall coating locations. Hand or power trowel and grout to fill voids. When cured, remove trowel marks and roughness using method recommended by manufacturer.
- F. Apply grout coat, of type recommended by resinous flooring manufacturer, to fill voids in surface of final body coat and to produce wearing surface indicated.
- G. Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer.

3.3 FIELD QUALITY CONTROL

- A. Material Sampling: Contractor may at any time and any number of times during resinous flooring and wall coating application require material samples for testing for compliance with requirements.
1. Contractor will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.
 2. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
 3. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reapply flooring materials to comply with requirements.

3.4 PROTECTION

- A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

END OF SECTION 09 6723

RESINOUS FLOORING

09 6723 - 6

SECTION 09 6813 - TILE CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes modular, tufted carpet tile.
- B. Related Requirements:
 - 1. Division 09 Section "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
 - 2. Include installation recommendations for each type of substrate.
- B. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
 - 1. Carpet Tile: Full-size Sample.
 - 2. Exposed Edge, Transition, and Other Accessory Stripping: 6-inch- (150-mm-) long Samples.
- C. Sustainability: Provide the Statement of the Achievement Level the carpet has attained for Silver, 37 to 51 points, based on specific Sustainable Attribute Performance for all product stages according to ANSI/NSF 140.
- D. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.3: For tile carpet flooring, documentation from an independent testing agency indicating compliance with the FloorScore Standard.
 - 2. Recycled Content – Credit MR 4.2: Provide documentation indicating percentages of post-consumer and pre-consumer recycled content by weight per unit of product or assembly containing the product. Indicate the percentage of the dollar of the recycled content compared to the total dollar value of the product or assembly containing the product.
 - 3. Regional Materials – Credit MR 5.2: Where the distance to the Project site is 500 miles or less, indicate location and distance to the Project site of extraction, harvesting, recovery and manufacturing of all materials. Indicate the dollar value of the material cost of the product containing local/regional materials. Where product components are

sourced or manufactured in separate locations, provide location and percentage by weight of each component per unit of product.

4. Laboratory Test Reports for Credit EQ 4: For carpet and installation adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association.
- B. Fire-Test-Response Ratings: Where indicated, provide carpet tile identical to those of assemblies tested for fire response according to NFPA 253 by a qualified testing agency.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104.

1.9 FIELD CONDITIONS

- A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.

- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.10 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
 - 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
 - 2. Failures include, but are not limited to, more than 10 percent edge raveling, snags, runs, excess static discharge, loss of tuft bind strength, loss of face fiber, and delamination.
 - 3. Warranty Period: 10 years from date of Final Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE

- 1. Manufacturers: Subject to compliance with requirements, provide product by one of the following:
 - a. Lees
 - b. J&J, Invision
 - c. Patcraft
 - d. Tandus, C&A
- B. Styles, as Selected by Contracting Officer from manufacturer's full range:
- C. Color: As selected by Contracting Officer from manufacturer's full range.
- D. Applied Soil-Resistance Treatment: Manufacturer's standard material.
- E. Dye Method: 100 percent solution dyed.
- F. Fiber Type: Nylon, "duracolor"
- G. Pile Characteristic: Cut-and-loop pile.
- H. Gauge: 1/12" per inch min.
- I. Size: 24" x 24" nominal.
- J. Backing System: ICT-Fiberglass Reinforced Thermoplastic Composite Tile
- K. Performance Characteristics: As follows:
 - 1. Appearance Retention Rating: Heavy traffic, 3.0 minimum according to ASTM D 7330.
 - 2. Dry Breaking Strength: Not less than 100 lbf (445 N) according to ASTM D 2646.

3. Dimensional Tolerance: Within 1/32 inch (0.8 mm) of specified size dimensions, as determined by physical measurement.
4. Dimensional Stability: 0.2 percent or less according to ISO 2551 (Aachen Test).
5. Resistance to Insects: Comply with AATCC 24.
6. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC 165.
7. Colorfastness to Light: Not less than 4 after 40 AFU (AATCC fading units) according to AATCC 16, Option E.
8. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria, not less than 1-mm halo of inhibition for gram-negative bacteria, and no fungal growth, according to AATCC 174.
9. Electrostatic Propensity: Less than **3.0** kV according to AATCC 134.
10. Emissions: Provide carpet tile that complies with testing and product requirements of CRI's "Green Label Plus" program.
11. Emissions: Provide carpet tile that complies with the product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.
 1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
 2. Subfloor finishes comply with requirements specified in Division 03 Section "Cast-in-Place Concrete" for slabs receiving carpet tile.
 3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider and protrusions more than 1/32 inch (0.8 mm) unless more stringent requirements are required by manufacturer's written instructions.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.
- D. Clean metal substrates of grease, oil, soil and rust, and prime if directed by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.
- E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

- A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: As recommended in writing by carpet tile manufacturer.
- C. Maintain dye lot integrity. Do not mix dye lots in same area.
- D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- G. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
 - 1. Remove yarns that protrude from carpet tile surface.
 - 2. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protecting Indoor Installations."

- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 09 6813

SECTION 09 9100 - PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following interior substrates:
 - 1. Steel.
 - 2. Galvanized metal.
 - 3. Gypsum board.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. LEED Submittals:
 - 1. Product Data for Credit EQ 4.2: For paints and coatings, including printed statement of VOC content.
 - 2. Laboratory Test Reports for Credit EQ 4: For paints and coatings, documentation indicating that they meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- 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.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: 2 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.5 QUALITY ASSURANCE

- A. MPI
 - 1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
 - 2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Benjamin Moore & Co.
 - 2. Sherwin-Williams Company (The).

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 Contracting Officer from manufacturer's full range.
- 2.3 PRIMERS/SEALERS
- A. Sherwin Williams: ProBlock #B51W20
 - B. Benjamin Moore: Fresh Start #02300
- 2.4 METAL PRIMERS
- A. Primer, Alkyd, Anti-Corrosive, for Metal: MPI #79.
 - B. Primer, Alkyd, Quick Dry, for Metal: MPI #76.
 - C. Primer, Galvanized, Water Based: MPI #134.
- 2.5 WATER-BASED PAINTS
- A. Latex, Interior, Institutional Low Odor/VOC, (Eggshell): MPI #145. (Gloss Level 3)
 - B. Latex, Interior, Institutional Low Odor/VOC, Semi-Gloss (Semigloss): MPI #147. (Gloss Level 5)
- 2.6 SOLVENT-BASED PAINTS

- A. Alkyd, Interior, Semi-Gloss (Semigloss): MPI #47. (Gloss Level 5)

2.7 DRY FOG/FALL COATINGS

- A. Latex Dry Fog/Fall: MPI #118.

2.8 FLOOR COATINGS

- A. Sealer, Solvent Based, for Concrete Floors: MPI #104.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Masonry (Clay and CMU): 12 percent.
 - 3. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and re-prime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.
- F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
- 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 Structural, Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed in equipment rooms and occupied spaces, including but not limited to, the following:
 - a. Uninsulated plastic piping.
 - b. Uninsulated metal piping.
 - c. Pipe hangers and supports.
 - d. Metal conduit.
 - e. Tanks that do not have factory-applied final finishes.
 - f. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - g. Mechanical equipment that is indicated to have a factory-primed finish for field painting.

- h. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
Exterior surfaces of all exposed ductwork; and mechanical, electrical and plumbing equipment, piping, cable trays and conduit and piping, and structural work in locations scheduled to receive dry fog/fall paint.
 - i. Other items as directed by Contracting Officer.
- 2. Electrical Work:
 - a. Switchgear.
 - b. Panelboards.
 - c. Electrical equipment that is indicated to have a factory-primed finish for field painting.
- 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: Contractor will engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.
 - 1. Contractor shall touch up and restore coated surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating 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 Contracting Officer, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, Non-Polished Traffic Surfaces:
 - 1. Solvent-Based Clear Sealer System: MPI INT 3.2F.
 - a. First Coat: Sealer, solvent based, for concrete floors.
 - b. Topcoat: Sealer, solvent based, for concrete floors.

B. Steel Substrates:

1. Quick-Drying Enamel System (typical): MPI INT 5.1A.
 - a. Prime Coat: Quick-drying alkyd metal primer.
 - b. Intermediate Coat: Quick-drying enamel matching topcoat.
 - c. Topcoat: Quick-drying enamel (semigloss).
2. Water-Based Dry-Fall System: MPI INT 5.1A
 - a. Prime Coat: Waterborne dry fall.
 - b. Topcoat: Latex dry fog/fall or Waterborne dry fall.

C. Galvanized-Metal Substrates:

1. Latex over Waterborne Primer System: MPI INT 5.3J
 - a. Prime Coat: Primer, galvanized, water based.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5, Semigloss)

D. Wood Substrates: Including medium-density fiberboard, hardboard.

1. Latex System: MPI INT 6.4R.
 - a. Prime Coat: Interior latex-based wood primer.
 - b. Intermediate Coat: Interior latex matching topcoat.
 - c. Topcoat: Interior latex semigloss.

E. Gypsum Board Substrates:

1. Epoxy Latex System: MPI INT 9.2A.
 - a. Prime Coat: Interior latex primer/sealer.
 - b. Intermediate Coat: Interior latex epoxy matching topcoat.
 - c. Topcoat: Interior latex epoxy (satin).
2. Latex System: MPI INT 9.2A.
 - a. Prime Coat: Interior latex primer/sealer.
 - b. Intermediate Coat: Interior latex matching topcoat.
 - c. Topcoat: Interior latex (eggshell).

F. Colors:

1. Where color not specified, Contracting Officer will select during submittal process.
2. Exterior Doors: Sherwin Williams; 4007 Bronze. Gloss. Or approved equal.
3. Door Frames: Sherwin Williams; 7020 Black Fox. Gloss. Or approved equal.
4. Interior: Sherwin Williams; SW1088 Only Natural. Semi-gloss. Or Benjamin Moore; 2832B Cumulus Cloud. Semi-gloss. Or approved equal.

END OF SECTION 09 9123

SECTION 101100 - VISUAL DISPLAY UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Visual display board assemblies.
 - 2. Display rails.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and accessories for visual display units.
 - 2. Include electrical characteristics for motorized units.
- B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
 - 2. Product Data for Credit IEQ 4.4: For composite wood products, documentation indicating that the product contains no urea formaldehyde.
- C. Shop Drawings: For visual display units.
 - 1. Include plans, elevations, sections, details, and attachment to other work.
 - 2. Show locations of panel joints. Show locations of field-assembled joints for factory-fabricated units too large to ship in one piece.
 - 3. Include sections of typical trim members.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for surface-burning characteristics of tackboards.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For visual display units to include in maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver factory-fabricated visual display units completely assembled in one piece. If dimensions exceed maximum manufactured unit size, or if unit size is impracticable to ship in one piece, provide two or more pieces with joints in locations indicated on approved Shop Drawings.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install visual display units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Verify actual dimensions of construction contiguous with visual display units by field measurements before fabrication.
 - 1. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

1.8 WARRANTY

- A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Surfaces lose original writing and erasing qualities.
 - b. Surfaces exhibit crazing, cracking, or flaking.
 - 2. Warranty Period: 50 years

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of visual display unit from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 50 or less.

2.3 VISUAL DISPLAY BOARD ASSEMBLY

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AARCO Products, Inc.
 - 2. Best-Rite Manufacturing; a brand division of MooreCo, Inc.
 - 3. Claridge Products and Equipment, Inc.

4. Newline Products, Inc.
- B. Visual Display Board Assembly: factory fabricated.
1. Assembly: markerboard tackboard.
 2. Corners: Square.
 3. Width: As indicated on Drawings.
 4. Height: 48"
 5. Mounting Method: Rail support system.
- C. Markerboard Panel: Porcelain-enamel-faced markerboard panel on core indicated.
1. Color: White.
- D. Tackboard Panel: Vinyl-fabric-faced tackboard panel on core indicated.
1. Fabric Wrapped Edge: Wrap edge of tackboard panel with fabric facing.
 2. Color and Pattern: As selected by Contracting Officer from full range of industry colors.
- E. Aluminum Frames and Trim: Fabricated from not less than 0.062-inch- thick, extruded aluminum; standard size and shape.
1. Field-Applied Trim: Manufacturer's standard, snap-on trim with no visible screws or exposed joints.
 2. Aluminum Finish: Clear anodic finish.
- F. Chalktray: Manufacturer's standard; continuous.
1. Box Type: Extruded aluminum with slanted front, grooved tray, and cast-aluminum end closures.
- G. Display Rail: Manufacturer's standard, extruded-aluminum display rail with plastic-impregnated-cork insert, end stops, and continuous paper holder, designed to hold accessories.
1. Size: 2 inch high by full length of visual display unit.
 2. Map Hooks and Clips: Two map hooks with flexible metal clips for every 48 inches of display rail or fraction thereof.
 3. Tackboard Insert Color: As selected by Contracting Officer from full range of industry colors.
 4. Aluminum Color: Match finish of visual display assembly trim.
- H. Paper Holder Display Rail: Extruded aluminum; designed to hold paper by clamping action.

2.4 MARKERBOARD PANELS

- A. Porcelain-Enamel Markerboard Panels: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction, consisting of moisture-barrier backing, core material, and porcelain-enamel face sheet with high-gloss finish. Laminate panels under heat and pressure with manufacturer's standard, flexible waterproof adhesive.
1. Face Sheet Thickness: 0.013 inch uncoated base metal thickness.
 2. Manufacturer's Standard Core: Minimum 1/4 inch thick, with manufacturer's standard moisture-barrier backing.
 3. Laminating Adhesive: Manufacturer's standard moisture-resistant thermoplastic type.

2.5 TACKBOARD PANELS

- A. Tackboard Panels:
 - 1. Core: Manufacturer's standard.

2.6 MATERIALS

- A. Porcelain-Enamel Face Sheet: PEI-1002, with face sheet manufacturer's standard two- or three-coat process.
- B. Plastic-Impregnated-Cork Sheet: Seamless, homogeneous, self-sealing sheet consisting of granulated cork, linseed oil, resin binders, and dry pigments that are mixed and calendared onto fabric backing; with washable vinyl finish and integral color throughout with surface-burning characteristics indicated.
- C. Extruded Aluminum: ASTM B 221, Alloy 6063.
- D. Adhesives for Field Application: Mildew-resistant, nonstaining adhesive for use with specific type of panels, sheets, or assemblies; and for substrate application; as recommended in writing by visual display unit manufacturer.
 - 1. Adhesives shall have a VOC content of 50 g/L or less.

2.7 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are 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.

2.8 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.
- B. Examine walls and partitions for proper preparation and backing for visual display units.
- C. Examine walls and partitions for suitable framing depth where sliding visual display units will be installed.

- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances, such as dirt, mold, and mildew, that could impair the performance of and affect the smooth, finished surfaces of visual display boards.
- C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display units and wall surfaces.
- D. Prime wall surfaces indicated to receive visual display units and as recommended in writing by primer/sealer manufacturer and visual display unit manufacturer.
- E. Prepare recesses for sliding visual display units as required by type and size of unit.

3.3 INSTALLATION

- A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
- B. Factory-Fabricated Visual Display Board Assemblies: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display board assemblies with fasteners at not more than 16 inches o.c. Secure tops and bottoms of boards to walls.
- C. Visual Display Board Assembly Mounting Heights: Install visual display units at mounting heights indicated on Drawings, or if not indicated, at heights indicated below.
 - 1. Mounting Height : 36 inches above finished floor to top of chalktray.

3.4 CLEANING AND PROTECTION

- A. Clean visual display units according to manufacturer's written instructions. Attach one removable cleaning instructions label to visual display unit in each room.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.
- C. Cover and protect visual display units after installation and cleaning.

END OF SECTION 101100

SECTION 101423 - PANEL SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Room-identification signs.
 - 2. Permanent Function room signs.
 - 3. Restroom signage.

1.3 DEFINITIONS

- A. Accessible: In accordance with the accessibility standard.

1.4 COORDINATION

- A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For panel signs.
 - 1. Include fabrication and installation details and attachments to other work.
 - 2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
 - 3. Show message list, timesteps, graphic elements, including raised characters and Braille, and layout for each sign at least half size.
- C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
 - 1. Include representative Samples of available timesteps and graphic symbols.
- D. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.

1.7 CLOSEOUT SUBMITTALS

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

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify locations of anchorage devices embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Deterioration of embedded graphic image.
 - c. Separation or delamination of sheet materials and components.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANEL SIGNS, GENERAL

- A. Regional Materials: Panel signs shall be manufactured within 500 miles of Project site.

2.2 SIGNS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Best Sign Systems
- B. Room-Identification Sign: Laminated-Sheet Sign with removable paper insert
 - a. Face sheet with raised graphics laminated to acrylic backing sheet to produce composite sheet.
 - b. Raised copy of 1/32" from sign face plate and carved or blasted into laminate. Tactile characters shall be accompanied by Grade 2 braille.
 - c. Word/number signs shall be 5/8" high lettering on 2" x 8" plate.
 - d. Letters/numbers to be Standard Bold Condensed uppercase.
 - e. Sign border to be 3/8" wide, 1/32" raised, with 1/8" inside radius. Outside corners to be square.
 - f. Letters and numbers shall be left justified on sign. Grade 2 Braille shall be placed directly below last line of letters or numbers, except for room number signs, where they shall be placed directly behind the last number.
 - g. Clear plastic sheet for slide in, changeable message capability.
- C. Permanent room function sign: Same as Room-Identification sign except without changeable message panel.

- D. Restroom signage:
- a. Face sheet with raised graphics laminated to acrylic backing sheet to produce composite sheet.
 - b. Raised copy of 1/32" from sign face plate and carved or blasted into laminate. Tactile characters shall be accompanied by Grade 2 braille.
 - c. Word/number signs shall be 5/8" high lettering on 6" x 8" plate.
 - d. Letters/numbers to be Standard Bold Condensed uppercase.
 - e. Provide Universal Accessibility Symbol on raised copy.
 - f. Sign border to be 3/8" wide, 1/32" raised, with 1/8" inside radius. Outside corners to be square.
 - g. Letters and numbers shall be left justified on sign. Grade 2 Braille shall be placed directly below last line of letters or numbers, except for room number signs, where they shall be placed directly behind the last number.
- E. Size: signs shall be approximately 6" x 8" size, square corners.
- F. Colors as selected from Manufacturer's full range.
- G. Mounting system shall be with vinyl tape.
- H. Sign-Panel Perimeter: Finish edges smooth.

2.3 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
 4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 5. Internally brace signs for stability and for securing fasteners.
- B. Signs with Changeable Message Capability: Fabricate signs to allow insertion of changeable messages as follows:
1. For snap-in changeable inserts beneath removable face sheet, furnish one suction or other device to assist in removing face sheet. Furnish initial changeable insert.
 2. Provide computer template for changeable message.

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.

- C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.

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 signage work.
- B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
 - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
 - 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
 - 4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- B. Room-Identification Signs and Other Accessible Signage: Install in locations on walls according to accessibility standard.
- C. Mounting Methods:
 - 1. Mounting shall be double sided vinyl tape.
- D. Signs Mounted on Glass: Provide opaque sheet matching sign material and finish onto opposite side of glass to conceal back of sign.

3.3 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101423

SECTION 10 2113 - TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Stainless-steel toilet compartments configured as toilet enclosures and urinal screens.
- B. Related Sections:
 - 1. Division 06 Section "Miscellaneous Rough Carpentry" for blocking.
 - 2. Division 10 Section "Toilet, Bath, and Laundry Accessories".

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show locations of cutouts for compartment-mounted toilet accessories.
 - 2. Show locations of reinforcements for compartment-mounted grab bars.
 - 3. Show locations of centerlines of toilet fixtures.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of toilet compartment, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Comply with requirements in GSA's CID-A-A-60003, "Partitions, Toilets, Complete."
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

- C. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" and ICC/ANSI A117.1 for toilet compartments designated as accessible.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum Castings: ASTM B 26/B 26M.
- B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M).
- C. Brass Castings: ASTM B 584.
- D. Brass Extrusions: ASTM B 455.
- E. Steel Sheet: Commercial steel sheet for exposed applications; mill phosphatized and selected for smoothness.
1. Electrolytically Zinc Coated: ASTM A 879/A 879M, 01Z (03G).
 2. Hot-Dip Galvanized: ASTM A 653/A 653M, either hot-dip galvanized or galvanized.
- F. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.
- G. Stainless-Steel Castings: ASTM A 743/A 743M.
- H. Zamac: ASTM B 86, commercial zinc-alloy die castings.

2.2 STEEL UNITS, Powder Coated/Baked Enamel finish

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Accurate Partitions Corporation.
 2. All American Metal Corp.
 3. American Sanitary Partition Corporation.
 4. Bradley Corporation; Mills Partitions.
 5. Flush Metal Partition Corp.
 6. General Partitions Mfg. Corp.
 7. Global Steel Products Corp.
- B. Toilet-Enclosure Style: Floor anchored.

- C. Urinal-Screen Style: 18 inch, wall hung with integral flanges.
- D. Door, Panel, and Pilaster Construction: Seamless, metal facing sheets pressure laminated to core material; with continuous, interlocking molding strip or lapped-and-formed edge closures; corners secured by welding or clips and exposed welds ground smooth. Exposed surfaces shall be free of pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections.
 - 1. Core Material: Manufacturer's standard sound-deadening honeycomb of resin-impregnated kraft paper in thickness required to provide finished thickness of 1 inch (25 mm) for doors and panels and 1-1/4 inches (32 mm) for pilasters.
 - 2. Grab-Bar Reinforcement: Provide concealed internal reinforcement for grab bars mounted on units.
 - 3. Tapping Reinforcement: Provide concealed reinforcement for tapping (threading) at locations where machine screws are used for attaching items to units.
- E. Urinal-Screen Construction:
 - 1. Integral-Flange, Wall-Hung Urinal Screen: Similar to panel construction, with integral full-height flanges for wall attachment, and maximum 1-1/4 inches (32 mm) thick.
- F. Facing Sheets and Closures: Stainless-steel sheet of nominal thicknesses as follows:
 - 1. Pilasters, Unbraced at One End: Manufacturer's standard thickness, but not less than 0.050 inch (1.27 mm).
 - 2. Panels: Manufacturer's standard thickness, but not less than 0.031 inch (0.79 mm).
 - 3. Doors: Manufacturer's standard thickness, but not less than 0.031 inch (0.79 mm).
 - 4. Integral-Flange, Wall-Hung Urinal Screens: Manufacturer's standard thickness, but not less than 0.031 inch (0.79 mm).
- G. Pilaster Shoes and Sleeves (Caps): Stainless-steel sheet, not less than 0.031-inch (0.79-mm) nominal thickness and 3 inches (76 mm) high, finished to match hardware.
- H. Stainless-Steel Finish: No. 4 satin, on exposed faces. Protect exposed surfaces from damage by application of strippable, temporary protective covering before shipment.

2.3 ACCESSORIES

- A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.
 - 1. Material: Stainless steel.
 - 2. Hinges: Manufacturer's standard.
 - 3. Latch and Keeper: Manufacturer's standard recessed latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
 - 4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
 - 5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
 - 6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.

- B. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match the items they are securing, with theft-resistant-type heads. Continuous heavy duty stainless steel wall brackets are predrilled. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.

2.4 FABRICATION

- A. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.
- B. Urinal-Screen Posts: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment at tops and bottoms of posts. Provide shoes and sleeves (caps) at posts to conceal anchorage.
- C. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide, in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide, out-swinging doors with a minimum 32-inch- (813-mm-) wide, clear opening for compartments designated as accessible.
- D. Urinal Screen Size: Provide 18-inch (452-mm-) wide screen, with posts extending from floor to top of screen and sized to provide clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
 - 1. Maximum Clearances:
 - a. Pilasters and Panels: 1/2 inch (13 mm).
 - b. Panels and Walls: 1 inch (25 mm).
- B. Floor-Anchored Units: Set pilasters with anchors penetrating not less than 2 inches (51 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.
- C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.
- D. No evidence of cutting, drilling and/or patching shall be visible on the finished work.
- E. Finished surfaces shall be cleaned after installation and be left free of all imperfections.

3.2 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 10 2113

SECTION 10 2226 - OPERABLE PARTITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Manually operated, paired panel folding acoustical partitions.

- B. Related Sections:

- 1. Division 05 Section "Metal Fabrications" for supports that attach supporting tracks to overhead structural system.
 - 2. Division 26 and 27 Sections for electrical service and connections for motor operators, controls, and limit switches; and for system disconnect switches.

1.3 DEFINITIONS

- A. STC: Sound Transmission Class.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design operable panel partitions, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Seismic Performance: Operable panel partitions shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 - 1. The term "withstand" means "the panels will remain in place without separation of any parts from the system when subjected to the seismic forces specified."
- C. Acoustical Performance: Provide operable panel partitions tested by a qualified testing agency for the following acoustical properties according to test methods indicated:
 - 1. Sound-Transmission Requirements: Operable panel partition assembly tested for laboratory sound-transmission loss performance according to ASTM E 90, determined by ASTM E 413, and rated for not less than the STC indicated.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. For installed products indicated to comply with design loads, include structural analysis data for attachments, signed and sealed by the qualified professional engineer responsible for their preparation.
 - 2. Indicate storage and operating clearances. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.
 - 3. Wiring Diagrams: For power, signal, and control wiring.
- C. Samples for Initial Selection: For each type of exposed material, finish, covering, or facing indicated.
 - 1. Include similar Samples of accessories involving color selection.
- D. Delegated-Design Submittal: For operable panel partitions indicated to comply with performance requirements, including analysis data and calculations signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Design Calculations: Calculate requirements for seismic restraints.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Suspended ceiling components.
 - 2. Structural members to which suspension systems will be attached.
 - 3. Size and location of initial access modules for acoustical tile.
 - 4. Items penetrating finished ceiling, including the following:
 - a. Lighting fixtures.
 - b. HVAC ductwork, outlets, and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Smoke detectors.
 - f. Access panels.
 - 5. Plenum acoustical barriers.
- B. Qualification Data: For qualified Installer.
- C. Seismic Qualification Certificates: For operable panel partitions, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

- D. Product Certificates: For each type of operable panel partition, from manufacturer.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each operable panel partition.
- F. Warranty: Sample of special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For operable panel partitions to include in maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Panel finish facings and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.
 - 2. Seals, hardware, track, carriers, and other operating components.
 - 3. Electric operator.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Fire-Test-Response Characteristics: Provide panels with finishes meeting one of the following as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - 1. Surface-Burning Characteristics: As determined by testing per ASTM E 84.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
 - 2. Fire Growth Contribution: Meeting acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protectively package and sequence panels in order for installation. Clearly mark packages and panels with numbering system used on Shop Drawings. Do not use permanent markings on panels.

1.10 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of operable panel partition openings by field measurements before fabrication.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of operable panel partitions that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Faulty operation of operable panel partitions.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal wear.
 - 2. Warranty Period: Two years from date of Final Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Steel Frame: Steel sheet, manufacturer's standard nominal minimum thickness for uncoated steel.
- B. Steel Face/Liner Sheets: Tension-leveled steel sheet, manufacturer's standard nominal minimum thickness for uncoated steel.

2.2 OPERABLE ACOUSTICAL PANELS

- A. Manually-Operated Acoustical Panel Systems: Horizontally sliding, operable acoustical panel partition system, including panels, seals, finish facing, suspension system, and accessories.
 - 1. Manufacturers: Subject to compliance with requirements, provide product by one of the following:
 - a. Modernfold, Inc; Acousti-Seal 932, (Basis of Design).
 - b. KWIK-WALL Company.
 - c. Panelfold Inc.
 - 2. Panel Operation:
 - a. Manually operated, paired panels
- B. Panel Construction: Provide top reinforcement as required to support panel from suspension components and provide reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.
- C. Dimensions: Fabricate operable acoustical panel partitions to form an assembled system of dimensions indicated and verified by field measurements.
 - 1. Panel Width: Standard widths.
- D. STC: Not less than 50.
- E. Panel Weight: 8 lb/sq. ft. (40 kg/sq. m) maximum.

- F. Panel Thickness: Not less than 3 inches (75 mm).
- G. Panel Closure:
 - 1. Initial Closure: Flexible, resilient PVC, bulb-shaped acoustical seal.
 - 2. Final Closure, Manually Operated Panel System: Constant-force, lever-operated mechanical closure expanding from panel edge to create a constant-pressure acoustical seal.
- H. Hardware: Manufacturer's standard as required to operate operable panel partition and accessories; with decorative, protective finish.
 - 1. Hinges: Concealed (invisible).

2.3 SEALS

- A. General: Provide types of seals indicated that produce operable panel partitions complying with acoustical performance requirements and the following:
 - 1. Manufacturer's standard seals.
 - 2. Seals made from materials and in profiles that minimize sound leakage.
 - 3. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between operable panel partition perimeter and adjacent surfaces, when operable panel partition is extended and closed.
- B. Vertical Seals: Deep-nesting, interlocking astragals mounted on each edge of panel, with continuous PVC acoustical seal.
- C. Horizontal Top Seals:
 - 1. Continuous-contact, extruded-PVC seal exerting uniform constant pressure on track.
- D. Horizontal Bottom Seals: PVC-faced, mechanical, retractable, constant-force-contact seal exerting uniform constant pressure on floor when extended, ensuring horizontal and vertical sealing and resisting panel movement.
 - 1. Automatically Operated for Acoustical Panels: Extension and retraction of bottom seal automatically operated by movement of partition, with operating range not less than [1 inch (25 mm)] between retracted seal and floor finish.

2.4 FINISH FACING

- A. General: Provide finish facings for panels that comply with indicated fire-test-response characteristics and that are factory applied to operable panel partitions with appropriate backing, using mildew-resistant nonstaining adhesive as recommended by facing manufacturer's written instructions.
 - 1. Apply one-piece, seamless facings free of air bubbles, wrinkles, blisters, and other defects, with no gaps or overlaps. Horizontal seams are not permitted. Tightly secure and conceal raw and selvage edges of facing for finished appearance.
 - 2. Color/Pattern: As selected by Architect from manufacturer's full range.

- B. Fabric Wall Covering: Manufacturer's standard fabric, from same dye lot, treated to resist stains.
- C. Trimless Edges: Fabricate exposed panel edges so finish facing wraps uninterrupted around panel, covering edge and resulting in an installed partition with facing visible on vertical panel edges, without trim, for minimal sightlines at panel-to-panel joints.

2.5 SUSPENSION SYSTEMS

- A. Suspension Tracks: Steel or aluminum with adjustable steel hanger rods for overhead support, designed for type of operation, size, and weight of operable panel partition indicated. Size track to support partition operation and storage without damage to suspension system, operable panel partitions, or adjacent construction. Limit track deflection to no more than 0.10 inch (2.54 mm) between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.
 - 1. Panel Guide: Aluminum; finished with factory-applied, decorative, protective finish.
 - 2. Head Closure Trim: As required for acoustical performance; with factory-applied, decorative, protective finish.
- B. Carriers: Trolley system as required for configuration type, size, and weight of partition and for easy operation; with ball-bearing wheels.
- C. Switches, and Accessories: As required for type of operation, storage, track configuration, and layout indicated for operable panel partitions, and compatible with partition assembly specified. Fabricate track intersections and switches from steel or aluminum.
- D. Aluminum Finish: Mill finish or manufacturer's standard, factory-applied, decorative finish unless otherwise indicated.
- E. Steel Finish: Manufacturer's standard, factory-applied, corrosion-resistant, protective coating unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable panel partitions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Comply with ASTM E 557 except as otherwise required by operable panel partition manufacturer's written installation instructions.
- B. Install operable panel partitions and accessories after other finishing operations, including painting, have been completed.

- C. Install panels from marked packages in numbered sequence indicated on Shop Drawings.
- D. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.
- E. Broken, cracked, deformed, or unmatched gasketing or gasketing with gaps at butted ends is not acceptable.

3.3 ADJUSTING

- A. Adjust operable panel partitions to operate smoothly, without warping or binding. Lubricate hardware, electric operator, and other moving parts.

3.4 CLEANING

- A. Clean soiled surfaces of operable panel partitions to remove dust, loose fibers, fingerprints, adhesives, and other foreign materials according to manufacturer's written instructions.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable panel partitions.

END OF SECTION 10 2226

SECTION 10 2600 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Corner guards (for all gypsum board wall outside corners).
2. Chair rails.

1.3 ACTION SUBMITTALS

- A. Product Data: Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes for each impact-resistant wall protection unit.

- B. LEED Submittals:

1. Certificates for Credit MR 6 or Credit MR 7: Chain-of-custody certificates certifying that wood rails comply with forest certification requirements. Include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.
2. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
3. Product Data for Credit IEQ 4.4: For particleboard, documentation indicating that products contain no urea formaldehyde.
4. Laboratory Test Reports for Credit IEQ 4: For adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- C. Shop Drawings: For each impact-resistant wall protection unit showing locations and extent. Include sections, details, and attachments to other work.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Source Limitations: Obtain impact-resistant wall protection units from single source from single manufacturer.
- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of impact-resistant wall protection units and are based on the specific system indicated. Refer to Division 01 Section "Quality Requirements."

1. Do not modify intended aesthetic effects, as judged solely by Contracting Officer, except with Contracting Officer approval. If modifications are proposed, submit comprehensive explanatory data to Contracting Officer for review.

- D. Surface-Burning Characteristics: Provide impact-resistant, plastic wall protection units with surface-burning characteristics as determined by testing identical products per ASTM E 84, NFPA 255, or UL 723 by UL or another qualified testing agency.
- E. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store impact-resistant wall protection units in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
 1. Maintain room temperature within storage area at not less than 70 deg F (21 deg C) during the period plastic materials are stored.
 2. Keep plastic sheet material out of direct sunlight.
 3. Store plastic wall protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F (21 deg C).
 - a. Store corner-guard covers in a vertical position.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install impact-resistant wall protection units until building is enclosed and weatherproof, wet work is complete and dry, and HVAC system is operating and maintaining temperature at 70 deg F (21 deg C) for not less than 72 hours before beginning installation and for the remainder of the construction period.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of impact-resistant wall protection units that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures.
 - b. Deterioration of plastic and other materials beyond normal use.
 2. Warranty Period: Five years from date of Final Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Vinyl covers with vinyl retainer clips extruded from chemical and stain resistant polyvinyl chloride with the addition of impact modifiers. No plasticizers shall be added.
- B. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

2.2 CORNER GUARDS

- A. Manufacturers: Subject to compliance with requirements, provide, or comparable product by one of the following:
 - 1. IPC Door and Wall Protection Systems; Division of InPro Corporation. (Basis of Design)
 - 2. Balco, Inc.
 - 3. Construction Specialties, Inc.
 - 4. Korogard Wall Protection Systems; a division of RJF International Corporation.
- B. Product No.: 164BN
 - 1. Material: Vinyl with retainer.
 - a. Thickness: Minimum 0.080 inch (2 mm)
 - b. Finish: Manufacturer's standard finish
 - c. Color: As selected by Contracting Officer from Manufacturer's full line of standard colors.
 - 2. Size: Nominal 48" x 2"
 - 3. Corner Radius: Standard
 - 4. Mounting: Standard vinyl retainer clip: 0.070 inch.
 - 5. Matching top and bottom cap.

2.3 CHAIR RAILS

- A. Provide continuous chair rail in hall room 103.
- B. Manufacturers: Subject to compliance with requirements, provide, or comparable product by one of the following:
 - 1. IPC Door and Wall Protection Systems; Division of InPro Corporation. (Basis of Design)
 - 2. Balco, Inc.
 - 3. Construction Specialties, Inc.
 - 4. Korogard Wall Protection Systems; a division of RJF International Corporation.
- C. Product No.: 2500
 - 1. Material: Vinyl with continuous aluminum retainer.
 - a. Thickness: Minimum 0.070 inch (2 mm)
 - b. Finish: Manufacturer's standard finish
 - c. Color: As selected by Contracting Officer from Manufacturer's full line of standard colors.

2. Size: Nominal 2" height
3. Mounting: Standard aluminum continuous retainer clip: 0.060 inch.
4. Matching end caps.

2.4 FABRICATION

- A. Fabricate impact-resistant wall protection units to comply with requirements indicated for design, dimensions, and member sizes, including thicknesses of components.
- B. Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.
- C. Fabricate components with tight seams and joints with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances, fire rating, and other conditions affecting performance of work.
- B. Examine walls to which impact-resistant wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Complete finishing operations, including painting, before installing impact-resistant wall protection system components.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

- A. General: Install impact-resistant wall protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
 1. Install impact-resistant wall protection units in locations and at mounting heights indicated on Drawings or, if not indicated, at heights indicated below:
 - a. Install corner guards 4" above finished floor @ top of wall base.
 - b. Install chair rail up to vertical edge of corner guard on both sides.
 2. Screw on: Position the corner guard on the wall and attach it using the supplied screws.
 3. Remove the protective plastic covering from the exposed surface of the corner guard.

3.4 CLEANING

- A. Immediately after completion of installation, clean plastic covers and accessories using a standard, ammonia-based, household cleaning agent.

END OF SECTION 10 2600

SECTION 10 2800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Public-use washroom accessories.
 - 2. Public-use shower room accessories.
 - 3. Mirrors

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:
 - 1. Construction details and dimensions.
 - 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 3. Material and finish descriptions.
 - 4. Features that will be included for Project.
 - 5. Manufacturer's warranty.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
 - 1. Identify locations using room designations indicated.
 - 2. Identify products using designations indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.7 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.8 WARRANTY

- A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 10 years from date of Final Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.
- B. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.
- C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch (0.9-mm) minimum nominal thickness.
- D. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip zinc coating.
- E. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.
- I. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, unless otherwise noted:
 - 1. American Specialties, Inc
 - 2. Bobrick Washroom Equipment, Inc.
 - 3. Bradley Corporation.
 - 4. Georgia-Pacific
- B. Paper Towel Dispenser and waste receptacle
 - 1. Recessed with spacing collar for 4" deep wall
 - 2. Material and Finish: Type 304 22 gauge stainless steel cabinet, satin
 - 3. Stainless piano hinge full length of hinged compartments
 - 4. Removable stainless steel waste container.

5. Capacity: 600 C-fold, 800 multifold or 1,100 single fold paper towels
6. Lockset: Tumbler type
7. Provide were indicated on plans.

C. Toilet Tissue Dispenser:

1. Two roll capacity, standard toilet tissue
2. Mounting: Surface mounted.
3. Material and Finish: 304 Stainless steel
4. Lockset: Tumbler type.
5. Provide (1) per toilet fixture.

D. Liquid-Soap Dispenser:

1. Description: Surface mounted.
2. Provided by owner. Installed by contractor.
3. Provide (1) at each sink.

E. Grab Bar :

1. Bobrick B6806 series; (Basis of Design)
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 18 guage (1.2 mm) thick.
 - a. Finish: Smooth, No. 4 finish (satin).
4. Outside Diameter: 1-1/2 inches (38 mm).
5. Configuration and Length: As indicated on Drawings.

F. Sanitary-Napkin Disposal Unit :

1. Bobrick B-270 (Provide on per women's water closet); (Basis of Design).
2. Mounting: Surface mounted.
3. Door or Cover: Self-closing, disposal-opening cover and hinged face panel with tumbler lockset.
4. Receptacle: Removable.
5. Material and Finish: Stainless steel, No. 4 finish (satin).

G. Mirror Unit:

1. ASTM C 1503 Silvered flat glass mirrors.
2. Tempered Glass Mirrors: Mirror Glazing Quality for blemish requirements and complying with ASTM C 1048 for Kind FT, Condition A, tempered float glass before silver coating is applied; clear.
 - a. Nominal Thickness: 1/4"
3. Top and bottom aluminum J-channels: Clear anodized aluminum extrusions with a return deep enough to provide enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover edges of mirrors in a single piece.
 - a. Form with front leg and back leg not less than 3/8" and 7/8" in height respectively, and a thickness not less than 0.04 inch.
4. Provide continuous mirror unit from wall to wall above lavatory sinks in men's and women's restrooms.

2.3 PUBLIC-USE SHOWER ROOM ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide product by one of the following:
 - 1. American Specialties, Inc.
 - 2. Bobrick Washroom Equipment, Inc.
 - 3. Bradley Corporation.

- B. Shower Curtain Rod:
 - 1. Bobrick B-6047 series, (Basis of Design).
 - 2. Description: 1-1/4-inch (32-mm) OD; fabricated from nominal 0.05-inch- (1.3-mm-) thick stainless steel.
 - 3. Mounting Flanges: Stainless-steel flanges designed for exposed fasteners.
 - 4. Finish: No. 4 (satin).

- C. Shower Curtain:
 - 1. Provided by Owner

- D. Shower Seat :
 - 1. Bobrick B-5191 Surface Mounted Shower Seat, (Basis of Design).
 - 2. Configuration: Rectangular seat.
 - 3. Seat: Phenolic or polymeric composite of slat-type or one-piece construction in color as selected by Contracting Officer.
 - 4. Mounting Mechanism: Stainless steel, No. 4 finish (satin).
 - 5. Dimensions: as shown on drawings.

- E. Robe Hook /Towel Pin:
 - 1. Bobrick B-6777 Surface Mounted, (Basis of Design).
 - 2. Finish: Satin-finish Stainless Steel.
 - 3. Provide qty as shown on plans.

2.4 UNDERLAVATORY GUARDS

- A. Under lavatory Guard:
 - 1. Reference MEP specifications

2.5 CUSTODIAL ACCESSORIES

- A. Mop and Broom holder – Utility Shelf:
 - 1. Combination unit shelf and holder
 - 2. Size: 30" long x 8" deep
 - 3. Antislip, spring loaded rubber mop and broom holders, and rag hooks. Provide with 4 hooks and 4 holders
 - 4. Drying rod below shelf for wet rags.
 - 5. Material and Finish: 304 stainless steel; satin

2.6 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 10 2800

SECTION 10 4413 - FIRE EXTINGUISHER CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fire protection cabinets and wall brackets for the following:
 - a. Contractor-provided portable fire extinguishers.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.
 - 1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
- B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For fire protection cabinets to include in maintenance manuals.

1.5 COORDINATION

- A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. 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. Sheet: ASTM B 209 (ASTM B 209M).
 - 2. Extruded Shapes: ASTM B 221 (ASTM B 221M).
- C. Stainless-Steel Sheet: ASTM A 666, Type 304.
- D. 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. Products: Subject to compliance with requirements, provide one of the following:
 - a. Larsen's Manufacturing Company; 2409-6R; (Basis of Design).
 - b. J. L. Industries, Inc., a division of Activar Construction Products Group.
 - c. Watrous Division, American Specialties, Inc.
- B. Cabinet Construction: Nonrated.
- C. Cabinet Material: Steel sheet.
 - 1. Shelf: Same metal and finish as cabinet.
- D. Semirecessed Cabinet: Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semirecessed cabinet installation.
 - 1. Rolled-Edge Trim: 2-1/2-inch (64-mm) backbend depth.
- E. Cabinet Trim Material: Aluminum sheet or extruded-aluminum shapes.
- F. Door Material: Aluminum sheet.
- G. Door Style: Vertical duo panel with frame.
- H. Door Glazing: Acrylic sheet.
 - 1. Acrylic Sheet Color: Clear transparent acrylic sheet.
- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 - 1. Provide projecting door pull and friction latch.
 - 2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.
- J. Accessories:

1. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.
 - a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER".
 - 1) Location: Applied to cabinet door.
 - 2) Application Process: Pressure-sensitive vinyl letters.
 - 3) Lettering Color: Red.
 - 4) Orientation: Vertical.

K. Finishes:

1. Manufacturer's standard baked-enamel paint for the following:
 - a. Exterior of cabinet, door, and trim except for those surfaces indicated to receive another finish.
 - b. Interior of cabinet.
2. Aluminum: Clear anodic.
3. Steel: Baked enamel or powder coat.

2.3 FIRE EXTINGUISHER BRACKET

- A. Provide bracket suitable for holding fire extinguisher on steel column in Mobility Storage area.

2.4 FABRICATION

- A. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
1. Weld joints and grind smooth.
 2. Provide factory-drilled mounting holes.
- 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.

2.5 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

- C. Finish fire protection cabinets after assembly.
- D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 ALUMINUM FINISHES

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

2.7 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" or SSPC-SP 8, "Pickling".
- B. 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 Contracting Officer from manufacturer's full range.

2.8 FIRE EXTINGUISHER

- A. Provide 5LB Class ABC Multipurpose Dry Chemical Extinguisher at cabinets and brackets.
- B. Coordinate with Owner's current contract provider for Fire Extinguishers and service.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare recesses for semirecessed fire protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

- A. General: Install fire protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights indicated below:
 - 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 semirecessed 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.
- C. Identification: Apply vinyl lettering at locations indicated.

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 4413

SECTION 105113 - METAL LOCKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Heavy-duty metal lockers.
 - 2. Locker room benches

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker and bench.
- B. Shop Drawings: For metal lockers. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show locker trim and accessories.
 - 2. Include locker identification system and numbering sequence.
- C. Samples for Initial Selection: For units with factory-applied color finishes.

1.4 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.5 LEED Submittals:

- A. Recycled Content- Credit MR 4.2: Provide documentation indicating percentages of post-consumer and pre-consumer recycled content by weight per unit of product or assembly containing the product. Indicate the percentage of the dollar value of the recycled content compared to the total dollar value of the product or assembly containing the product.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Regulatory Requirements: Where metal lockers and benches are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities".

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for their installation.

1.9 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of recessed openings by field measurements before fabrication.

1.10 COORDINATION

- A. Coordinate sizes and locations of wood bases for metal lockers.
- B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures.
 - b. Faulty operation of latches and other door hardware.
 - 2. Damage from deliberate destruction and vandalism is excluded.
 - 3. Warranty Period for All-Welded Metal Lockers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 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 A60 (ZF180) zinc-iron, alloy (galvannealed) coating designation.
- C. Stainless-Steel Sheet: ASTM A 666, Type 304.
- D. Fasteners: Zinc- or nickel-plated steel, slotless-type, exposed bolt heads; with self-locking nuts or lock washers for nuts on moving parts.
- E. Anchors: Material, type, and size required for secure anchorage to each substrate.
 - 1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls for corrosion resistance.
 - 2. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.2 HEAVY-DUTY METAL LOCKERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide All-Welded Defiant II Single Point Latch (SPL) by Penco Products or comparable product by one of the following:
 - 1. DeBourgh Mfg. Co

2. List Industries
 3. Lyon Workspace Products, LLC
- B. Locker arrangement: 18"x18"x 78" double tier.
- C. Material: Cold-rolled steel sheet.
- D. Body: Assembled by welding body components together. Fabricate from unperforated steel sheet with thicknesses as follows:
1. Tops, Bottoms, and Sides: 0.060-inch (1.52-mm) nominal thickness.
 2. Backs: 0.048-inch (1.21-mm) nominal thickness.
 3. Shelves: 0.060-inch (1.52-mm) nominal thickness, with double bend at front and single bend at sides and back.
- E. Doors: One piece; fabricated from 0.075-inch (1.90-mm) nominal-thickness steel sheet; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.
1. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches (381 mm) wide; welded to inner face of doors.
 2. Door Style:
 - a. Perforated Vents: Manufacturer's standard shape and configuration.
- F. Hinges: Welded to door and attached to door frame with no fewer than two factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.
1. Continuous Hinges: Manufacturer's standard, steel, full height.
- G. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond face of door; pry and vandal resistant.
1. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks or padlocks; positive automatic latching and prelocking.
 - a. Latch Hooks: Equip doors less than 48 inches (1219 mm) high with two latch hooks; fabricated from 0.120-inch (3.04-mm) nominal-thickness steel sheet; welded to full-height door strikes; with resilient silencer on each latch hook.
 - b. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact, and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.
- H. Combination Padlocks: No locks provided.
- I. Equipment: Equip each metal locker with identification plate and the following unless otherwise indicated:
1. Coat Rods: In lieu of ceiling hook for metal lockers 18 inches (457 mm) deep or more.
- J. Accessories:
1. Continuous Zee Base: Fabricated from, manufacturer's standard thickness, but not less than 0.060-inch (1.52-mm) nominal-thickness steel sheet.
 - a. Height: 4 inches (102 mm).
 2. Recess Trim: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.
 3. Filler Panels: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.
 4. Boxed End Panels: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.
- K. Finish: Baked enamel or powder coat.
1. Color(s): As selected by Contracting Officer from manufacturer's full range.

2.3 LOCKER BENCHES

- A. Provide bench units with overall assembly height of **17-1/2 inches (445 mm)**.
- B. Bench Tops: Manufacturer's standard one-piece units, with rounded corners and edges.
 - 1. Size: As Indicated on the drawings
 - 2. Laminated clear hardwood with one coat of clear sealer on all surfaces and one coat of clear lacquer on top and sides.
- C. Fixed Pedestals: Manufacturer's standard supports, with predrilled fastener holes for attaching bench top and anchoring to floor, complete with fasteners and anchors, and as follows:
 - 1. Tubular Steel: **1-1/2-inch- (38-mm-)** diameter steel tubing threaded on both ends, with standard pipe flange at top and bell-shaped cast-iron base; with baked-enamel or powder-coat finish; anchored with exposed fasteners.
 - a. Color: As selected by Contracting Officer from manufacturer's full range.

2.4 FABRICATION

- A. Fabricate metal lockers square, rigid, and without warp and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.
 - 1. Form body panels, doors, shelves, and accessories from one-piece steel sheet unless otherwise indicated.
 - 2. Provide fasteners, filler plates, supports, clips, and closures as required for complete installation.
- B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments. Factory weld frame members of each metal locker together to form a rigid, one-piece assembly.
- C. All-Welded Construction: Factory preassemble metal lockers by welding all joints, seams, and connections; with no bolts, nuts, screws, or rivets used in assembly of main locker groups. Factory weld main locker groups into one-piece structures. Grind exposed welds flush.
- D. Accessible Lockers: Fabricate as follows:
 - 1. Locate bottom shelf no lower than **15 inches (381 mm)** above the floor.
 - 2. Where hooks, coat rods, or additional shelves are provided, locate no higher than **48 inches (1219 mm)** above the floor.
- E. Coat Rods: Fabricated from **1-inch- (25-mm-)** diameter steel, chrome finished.
- F. Identification Plates: Manufacturer's standard, etched, embossed, or stamped aluminum plates, with numbers and letters at least **3/8 inch (9 mm)** high.
- G. Continuous Base: Formed into channel or zee profile for stiffness, and fabricated in lengths as long as practical to enclose base and base ends of metal lockers; finished to match lockers.
- H. Recess Trim: Fabricated with minimum **2-1/2-inch (64-mm)** face width and in lengths as long as practical; finished to match lockers.
- I. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip-joint filler angle formed to receive filler panel.

- J. Boxed End Panels: Fabricated with 1-inch- (25-mm-) wide edge dimension, and designed for concealing fasteners and holes at exposed ends of nonrecessed metal lockers; finished to match lockers.
 - 1. Provide one-piece panels for double-row (back-to-back) locker ends.

2.5 STEEL SHEET FINISHES

- A. Factory finish steel surfaces and accessories except stainless-steel and chrome-plated surfaces.
- B. Powder-Coat Finish: Immediately after cleaning and pretreating, electrostatically apply manufacturer's standard, baked-polymer, thermosetting powder finish. Comply with resin manufacturer's written instructions for application, baking, and minimum dry film thickness.

2.6 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. Run grain of directional finishes with long dimension of each piece.
 - 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. 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 INSTALLATION

- A. General: Install level, plumb, and true; shim as required, using concealed shims.
 - 1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches (910 mm) o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
 - 2. Anchor single rows of metal lockers to walls near top and bottom of lockers.
 - 3. Anchor back-to-back metal lockers to floor.
- B. All-Welded Metal Lockers: Connect groups together with standard fasteners, with no exposed fasteners on face frames.
- C. Equipment and Accessories: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.
 - 1. Attach door locks on doors using security-type fasteners.
 - 2. Identification Plates: Identify metal lockers with identification indicated on Drawings.
 - a. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.
 - b. Attach plates to upper shelf of each open-front metal locker, centered, with a least two aluminum rivets.

3. Attach recess trim to recessed metal lockers with concealed clips.
4. Attach filler panels with concealed fasteners. Locate filler panels where indicated on Drawings.
5. Attach sloping-top units to metal lockers, with closures at exposed ends.
6. Attach boxed end panels with concealed fasteners to conceal exposed ends of nonrecessed metal lockers.

3.3 ADJUSTING, CLEANING, AND PROTECTION

- A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding.
- B. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.
- C. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 105113

SECTION 111200 - PARKING CONTROL EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Automatic barrier gates.
 - 2. Vehicle detectors.
 - 3. Miscellaneous parking control equipment.
 - 4. Access control units.

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 parking control equipment.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties.
- B. Shop Drawings: For parking control equipment.
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 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. Include diagrams for power, signal, and control wiring.
 - 4. Vehicle Detectors: Layout and method of placement of vehicle loop detector system.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For parking control equipment to include in emergency, operation, and maintenance manuals.
- B. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
 - 3. Device address list.

4. Printout of software application and graphic screens.

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. Gate Arms: One breakaway gate arms for each gate installed, complete with accessory components.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain parking control equipment from single source from single manufacturer.

2.2 AUTOMATIC BARRIER GATES <Insert drawing designation>

- A. General: Provide parking control device consisting of operator and controller housed in a weathertight, tamper-resistant cabinet enclosure with gate arm. Device shall be activated by a signal from access or revenue control device. Fabricate unit with gate-arm height in down position of not more than 35 inches above pavement.
 - 1.
 2. Basis-of-Design Product: Subject to compliance with requirements, provide BL54, by Automatic Systems, IER Group or comparable product by one of the following:
 - a. Automatic Systems; a subsidiary of The IER Group.
 - b. DoorKing, Inc.
 - c. LiftMaster; The Chamberlain Group, Inc.
 - d. Operator Specialty Co., Inc.; Linear LLC group member.
- B. Standards: ASTM F 2200 for barrier gates and gate operators that are listed and labeled according to UL 325 by a qualified testing agency.
- C. Controller: Factory-sealed, solid-state, plug-in type, with galvanized-steel box for wiring connections.
 1. Type: Noncommunicating.
 - a. Capable of logic for one- and two-way lanes.
 2. Physical Characteristics:
 - a. On-off power supply switch.
 - b. Automatic-manual switch.
 - c. Differential counter.
 - d. Communication port.
 - e. Internal resettable counters.

- f. Thermal-overload protection with manual reset.
 - g. Plug-in connectors for two vehicle loop detectors.
 - h. Thermostatically controlled heater with on/off/auto switch.
 - i. Switch to test motor and limit switches.
 - j. Emergency manual disconnect.
 - k. Battery backup.
 - l. Single, 115-V ac grounded power receptacle.
3. Operational Characteristics:
- a. Able to store successive inputs and sequentially processing each one.
 - b. Automatic instant-reversing obstacle detector mechanism that stops downward motion of gate arm if arm contacts or nears an object and that immediately returns arm to upward position. Include a zero- to 60-second, variable-time reset device.
 - c. Directional arming logic.
 - d. Broken gate-arm monitoring.
 - e. Programmable automatic timer.
 - f. Diagnostic mode for on-site testing, with LEDs for inputs and outputs.
 - g. Automatic and continuous testing of inputs and outputs.
 - h. Reversible arm capability for right- or left-handed operation.
- D. Cabinets: Fabricated from sheet metal with seams welded and ground smooth; approximately 15 inches square by 40 inches tall. Provide single, gasketed access door for each cabinet with flush-mounted locks. Furnish two keys for each lock, all locks keyed alike. Fabricate cabinet with internal reinforcing and four mounting holes accessible only from inside cabinet.
- 1. Steel Sheet: Not less than 0.097-inch- thick, galvanized- steel sheet.
 - a. Finish cabinet, interior and exterior, with manufacturer's standard white baked-enamel or powder-coat finish.
- E. Wishbone-Style Gate Arm: One-piece extruded aluminum profile with tip plug. White enameled with red reflecting stripes. Provide mounting flange with breakaway feature to ensure a clean break if arm is struck by vehicle.
- 1. Length: 26 feet.
- F. Operator: UL labeled and listed, Class III. 1/2 hp, 60-Hz, single-phase, instant-reversing, continuous-duty motor for operating gate arm. Transmit power to gate-arm drive shaft through the speed reducer to harmonic-acting crank and connecting rod. Fabricate crank, rod, and drive shaft of galvanized solid bar steel. Provide an operable cam for adjusting arm travel.
- 1. Opening Time: Three seconds.
 - 2. Inherently adjustable, torque limiting clutch for safety.

2.3 VEHICLE DETECTORS

- A. General: Provide detection devices that sense presence or transit of vehicles and emit signals activating gate-arm operators.
- B. Vehicle Loop Detector System: Self-tuning electronic presence detector with adjustable detection patterns, adjustable sensitivity and frequency settings, and panel indicator light. Include automatic closing timer with adjustable time delay before closing, timer cut-off switch, designed to hold gate arm open until traffic clears. Provide number of loops consisting of multiple strands of wire, number of turns, loop size, and method of placement at location indicated on Drawings, as recommended in writing by detection system manufacturer for saw-cut installation.

1. Field-Assembled Loop: Wire, in size indicated for field assembly.
2. Operation:
 - a. Recognize vehicles within 6 inches of each other on standard-sized loop.
 - b. Recognize vehicle direction by detecting vehicle moving from one loop to another.
 - c. Generate reverse count if vehicle backs up after generating directional count in forward direction.
 - d. Continuous diagnostic monitoring for intermittently operating and failed loops.
 - e. Crosstalk test between adjacent loops.

2.4 ACCESS CONTROL UNITS

- A. General: Provide access control unit that activates barrier gates.
- B. Unit Housing: Fabricate from welded cold-rolled steel or aluminum sheet with weatherproof front access panel equipped with flush-mounted lock and two keys. Provide face-lighted unit fully visible at night.
 1. Steel Finish: Manufacturer's standard baked-enamel or powder-coat finish system.
- C. Card Reader Controlled Unit: Functions only when authorized card is presented.
 1. System: Programmable, multiple-code capability permitting validation or voiding of individual cards.
 - a. Permit four different access time periods.
 2. Reader: Proximity type for proximity cards.
 3. Characteristics: Timed antipassback Programmable by PDA (personal digital assistant) by infrared interface.
 4. Mounting: With pedestal.
 5. Cards: Coordinate with users existing ID card system
- D. Digital Keypad Controlled Unit: Functions only when authorized code is entered on keyed keypad.
 1. System: Programmable, multiple-code capability permitting validation or voiding of no fewer than 2500 possible individual codes, consisting of one to six digits, and permitting four different access time periods.
 2. Characteristics: Capable of monitoring and auditing barrier gate activity.
 3. Mounting: With pedestal.
- E. Radio-Controlled System: Digital access control system consisting of code-compatible universal coaxial receiver, one per barrier gate, remote antenna with coaxial cable and mounting brackets, and one permanently mounted transmitter(s) per receiver designed to operate barrier gates. Provide programmable transmitter with multiple-code capability permitting validation or voiding of no fewer than 1000 codes per channel configured for the following functions:
 1. Transmitters: Single-button operated, with open and close functions.

2.5 ANCHORAGES

- A. Anchor bolts; hot-dip galvanized according to ASTM A 153/A 153M and ASTM F 2329.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, including equipment bases; accurate placement, pattern, and orientation of anchor bolts; critical dimensions; and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical and communication systems to verify actual locations of connections before parking control equipment installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Excavation for Traffic Controllers: Saw cut existing pavement for recessed traffic controllers and hand-excavate recesses to dimensions and depths and at locations as required by traffic controller manufacturer's written instructions and as indicated on Drawings.

3.3 INSTALLATION

- A. General: Install parking control equipment as required for complete and integrated installation.
 - 1. Rough-in electrical connections.
- B. Automatic Barrier Gates: Anchor cabinets to concrete bases with anchor bolts or expansion anchors, and mount barrier gate arms.
 - 1. Install barrier gates according to UL 325.
- C. Vehicle Loop Detectors: Cut grooves in pavement and bury Bury and seal wire loop at locations indicated on Drawings according to manufacturer's written instructions. Connect to parking control equipment operated by detector.
- D.
 - 1. Connect equipment to remote computer.
- E.
- F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- G. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. 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.

B. Parking control equipment will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust parking control equipment to function smoothly, and lubricate as recommended by manufacturer.

B. Confirm that locks engage accurately and securely without forcing or binding.

C. After completing installation of exposed, factory-finished parking control equipment, inspect exposed finishes and repair damaged finishes.

3.6 PROTECTION

A. Remove barrier gate arms during the construction period to prevent damage, and install them immediately before Substantial Completion.

3.7 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain parking control equipment.

END OF SECTION 111200

SECTION 115213 - PROJECTION SCREENS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Electrically operated, front-projection screens and controls.

1.3 DEFINITIONS

- A. Gain: Ratio of light reflected from screen material to that reflected perpendicularly from a magnesium carbonate surface as determined per SMPTE RP 94.
- B. Half-Gain Angle: The angle, measured from the axis of the screen surface to the most central position on a perpendicular plane through the horizontal centerline of the screen where the gain is half of the peak gain.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show layouts and types of front-projection screens. Include the following:
 1. Location of screen centerline relative to ends of screen case.
 2. Anchorage details, including connection to supporting structure for suspended units.
 3. Details of juncture of exposed surfaces with adjacent finishes.
 4. Location of wiring connections for electrically operated units.
 5. Wiring diagrams for electrically operated units.
 6. Accessories.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For front-projection screens to include in maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Environmental Limitations: Do not deliver or install front-projection screens until spaces are enclosed and weathertight, 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.

1.7 COORDINATION

- A. Coordinate layout and installation of front-projection screens with adjacent construction, including ceiling suspension systems, light fixtures, HVAC equipment, fire-suppression system, and partitions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Projection Screens: Obtain each type of front-projection screen from single manufacturer. Obtain accessories, including necessary mounting hardware, from screen manufacturer.

2.2 ELECTRICALLY OPERATED, FRONT-PROJECTION SCREENS

- A. General: Manufacturer's standard units consisting of case, screen, motor, controls, mounting accessories, and other components necessary for a complete installation. Provide units that are listed and labeled as an assembly by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Controls: Remote, three-position control switch installed in recessed device box with flush cover plate matching other electrical device cover plates in room where switch is installed.
 - a. Provide one control switches for each screen.
 - b. Provide power supply for low-voltage systems if required.
 - 3. Motor in Roller: Instant-reversing motor of size and capacity recommended by screen manufacturer; with permanently lubricated ball bearings, automatic thermal-overload protection, preset limit switches to automatically stop screen in up and down positions, and positive-stop action to prevent coasting. Mount motor inside roller with vibration isolators to reduce noise transmission.
 - 4. Screen Mounting: Top edge securely anchored to rigid metal roller and bottom edge formed into a pocket holding a 3/8-inch- diameter metal rod with ends of rod protected by plastic caps.
 - a. Roller for end-mounted motor is supported by self-aligning bearings in brackets.
 - b. Roller for motor in roller is supported by vibration- and noise-absorbing supports.
 - 5. Tab Tensioning: Provide units that have a durable low-stretch cord, such as braided polyester, on each side of screen that is connected to edge of screen by tabs to pull screen flat horizontally. In lieu of tab tensioning, screens may be constructed from vinyl-coated screen cloth that contains horizontal stiffening monofilaments to resist edge curling.
- B. Suspended, Electrically Operated Screens with Automatic Ceiling Closure, with Motor-in Roller, and with Tab Tensioning: Units designed and fabricated for suspended mounting; with bottom of case composed of two panels, fully enclosing screen, motor, and wiring; one panel hinged and designed to open and close automatically when screen is lowered and fully raised, the other removable or openable for access to interior of case.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Da-Lite Screen Company; Tensioned Advantage Deluxe Electrol.
 - b. Draper Inc; Signature/Series V.

2. Provide metal or metal-lined wiring compartment.
3. Screen Case: Made from metal.
4. Provide screen case with trim flange to receive ceiling finish.
5. Finish on Exposed Surfaces: Vinyl covering or baked enamel.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install front-projection screens at locations indicated to comply with screen manufacturer's written instructions.
- B. Install front-projection screens with screen cases in position and in relation to adjoining construction indicated. Securely anchor to supporting substrate in a manner that produces a smoothly operating screen with vertical edges plumb and viewing surface flat when screen is lowered.
 1. Install low-voltage controls according to NFPA 70 and complying with manufacturer's written instructions.
 - a. Wiring Method: Install wiring in raceway except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use UL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.
 2. Test electrically operated units to verify that screen controls, limit switches, closures, and other operating components are in optimum functioning condition.

END OF SECTION 115213

SECTION 122113 - HORIZONTAL LOUVER BLINDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Horizontal louver blinds with aluminum slats.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show fabrication and installation details for horizontal louver blinds.
 - 1. Motorized Operators: Include details of installation in headrails and diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: For each type and color of horizontal louver blind.
 - 1. Include similar Samples of accessories involving color selection.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of horizontal louver blind.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For horizontal louver blinds to include in maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver horizontal louver blinds in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not install horizontal louver blinds until construction and wet and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

- B. Field Measurements: Where horizontal louver blinds are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain horizontal louver blinds from single source from single manufacturer.

2.2 HORIZONTAL LOUVER BLINDS, ALUMINUM SLATS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Hunter Douglas Contract.
 - 2. Levolor Contract; a Newell Rubbermaid company.
 - 3. Springs Window Fashions.
- B. Slats: Aluminum; alloy and temper recommended by producer for type of use and finish indicated; with crowned profile and radius corners.
 - 1. Width: 1/2 to 5/8 inch.
 - 2. Thickness: Manufacturer's standard .
 - 3. Spacing: Manufacturer's standard.
 - 4. Finish: Ionized antistatic, dust-repellent, baked polyester finish.
- C. Headrail: Formed steel or extruded aluminum; long edges returned or rolled. Headrails fully enclose operating mechanisms on three sides.
 - 1. Capacity: One blind per headrail unless otherwise indicated.
 - 2. Ends: Capped or plugged.
 - 3. Manual Lift-Operator and Tilt-Operator Lengths: Manufacturer's standard.
 - 4. Manual Lift-Operator and Tilt-Operator Locations: Manufacturer's standard unless otherwise indicated.
 - 5. Integrated Headrail/Valance: Curved face.
- D. Bottom Rail: Formed-steel or extruded-aluminum tube that secures and protects ends of ladders and lift cords and has plastic- or metal-capped ends.
 - 1. Type: Manufacturer's standard.
- E. Lift Cords: Manufacturer's standard braided cord.
- F. Ladders: Evenly spaced across headrail at spacing that prevents long-term slat sag.
 - 1. Type: Reinforced vinyl tape, manufacturer's standard width.
- G. Mounting Brackets: With spacers and shims required for blind placement and alignment indicated.
 - 1. Type: Wall or overhead.

2. Intermediate Support: Provide intermediate support brackets to produce support spacing recommended by blind manufacturer for weight and size of blind.

H. Colors, Textures, Patterns, and Gloss:

1. Slats: As selected by Architect from manufacturer's full range.
2. Components: Provide rails, cords, ladders, and materials exposed to view matching or coordinating with slat color unless otherwise indicated.

2.3 HORIZONTAL LOUVER BLIND FABRICATION

- A. Product Safety Standard: Fabricate horizontal louver blinds to comply with WCMA A 100.1 including requirements for corded, flexible, looped devices; lead content of components; and warning labels.
- B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:
 1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which blind is installed less 1/4 inch per side or 1/2 inch total, plus or minus 1/8 inch. Length equal to head-to-sill dimension of opening in which blind is installed less 1/4 inch, plus or minus 1/8 inch.
- C. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.
 1. Lift-and-Tilt Mechanisms: With permanently lubricated moving parts.
- D. Mounting and Intermediate Brackets: Designed for removal and reinstallation of blind without damaging blind and adjacent surfaces, for supporting blind components, and for bracket positions and blind placement indicated.
- E. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to brackets and adjoining construction; type designed for securing to supporting substrate; and supporting blinds and accessories under conditions of normal use.
- F. Color-Coated Finish:
 1. Metal: For components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install horizontal louver blinds level and plumb, aligned and centered on openings, and aligned with adjacent units according to manufacturer's written instructions.

1. Locate so exterior slat edges are not closer than 1 inch from interior faces of glass and not closer than 1/2 inch from interior faces of glazing frames through full operating ranges of blinds.
2. Install mounting and intermediate brackets to prevent deflection of headrails.
3. Install with clearances that prevent interference with adjacent blinds, adjacent construction, and operating hardware of glazed openings, other window treatments, and similar building components and furnishings.

3.3 ADJUSTING

- A. Adjust horizontal louver blinds to operate free of binding or malfunction through full operating ranges.

3.4 CLEANING AND PROTECTION

- A. Clean horizontal louver blind surfaces after installation according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions in a manner acceptable to manufacturer and Installer and that ensures that horizontal louver blinds are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged horizontal louver blinds that cannot be repaired in a manner approved by Architect before time of Substantial Completion.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain systems.

END OF SECTION 122113

SECTION 133419 - METAL BUILDING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Structural-steel framing.
2. Metal roof panels.
3. Foamed-insulation-core metal wall panels.
4. Metal soffit panels.
5. Accessories.

- B. Related Requirements:

1. Section 077253 "Snow Guards" for prefabricated devices designed to hold snow on the roof surface.
2. Section 083613 "Sectional Doors" for sectional vehicular doors in metal building systems.
3. Section 081113 "Hollow Metal Doors and Frames" For doors in metal building systems.
4. Section 084113 "Aluminum Framed Entrances and Storefronts" For doors and windows in metal building systems.

1.3 DEFINITIONS

- A. Terminology Standard: See MBMA's "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in standards referenced by this Section.

1.4 COORDINATION

- A. Coordinate sizes and locations of concrete foundations and casting of anchor-rod inserts into foundation walls and footings. Anchor rod installation, concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete."
- B. Coordinate metal panel assemblies with rain drainage work, flashing, trim, and construction of supports and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 1. Review methods and procedures related to metal building systems including, but not limited to, the following:
 - a. Condition of foundations and other preparatory work performed by other trades.

- b. Structural load limitations.
 - c. Construction schedule. Verify availability of materials and erector's personnel, equipment, and facilities needed to make progress and avoid delays.
 - d. Required tests, inspections, and certifications.
 - e. Unfavorable weather and forecasted weather conditions and impact on construction schedule.
2. Review methods and procedures related to metal roof panel assemblies including, but not limited to, the following:
 - a. Compliance with requirements for purlin and rafter conditions, including flatness and attachment to structural members.
 - b. Structural limitations of purlins and rafters during and after roofing.
 - c. Flashings, special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect metal roof panels.
 - d. Temporary protection requirements for metal roof panel assembly during and after installation.
 - e. Roof observation and repair after metal roof panel installation.
 3. Review methods and procedures related to metal wall panel assemblies including, but not limited to, the following:
 - a. Compliance with requirements for support conditions, including alignment between and attachment to structural members.
 - b. Structural limitations of girts and columns during and after wall panel installation.
 - c. Flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.
 - d. Temporary protection requirements for metal wall panel assembly during and after installation.
 - e. Wall observation and repair after metal wall panel installation.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of metal building system component.
 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Foamed-insulation core metal roof panels.
 - b. Foamed-insulation-core metal panels.
 - c. Metal soffit panels.
- B. LEED Submittals:
 1. Product Test Reports for Credit SS 7.2: For roofing materials, documentation indicating that roofing materials comply with Solar Reflectance Index requirement.
 2. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
- C. Shop Drawings: Indicate components by others. Include full building plan, elevations, sections, details and the following:
 1. Anchor-Rod Plans: Submit anchor-rod plans and templates before foundation work begins. Include location, diameter, and minimum required projection of anchor rods required to attach metal building to foundation. Indicate column reactions at each location.

2. Structural-Framing Drawings: Show complete fabrication of primary and secondary framing; include provisions for openings. Indicate welds and bolted connections, distinguishing between shop and field applications. Include transverse cross-sections.
 - a. Show provisions for attaching .
 3. Metal Roof Panel Layout Drawings: Show layouts of panels including methods of support. Include details of edge conditions, joints, panel profiles, corners, anchorages, clip spacing, trim, flashings, closures, and special details. Distinguish between factory- and field-assembled work; show locations of exposed fasteners.
 - a. Show roof-mounted items including roof hatches, equipment supports, pipe supports and penetrations, lighting fixtures, and items mounted on roof curbs.
 - b. Show wall-mounted items including personnel doors, vehicular doors, windows, louvers, and lighting fixtures.
 - c. Show translucent panels.
 4. Accessory Drawings: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:
 - a. Flashing and trim.
 - b. Gutters.
 - c. Downspouts.
- D. Delegated-Design Submittal: For metal building systems.
1. Include analysis data indicating compliance with performance requirements and design data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For erector manufacturer.
- B. Welding certificates.
- C. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:
 1. Name and location of Project.
 2. Order number.
 3. Name of manufacturer.
 4. Name of Contractor.
 5. Building dimensions including width, length, height, and roof slope.
 6. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
 7. Governing building code and year of edition.
 8. Design Loads: Include dead load, roof live load, collateral loads, roof snow load, deflection, wind loads/speeds and exposure, seismic design category or effective peak velocity-related acceleration/peak acceleration, and auxiliary loads (cranes).
 9. Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.
 10. Building-Use Category: Indicate category of building use and its effect on load importance factors.
- D. Erector Certificates: For qualified erector, from manufacturer.
- E. Material Test Reports: For each of the following products:

1. Structural steel including chemical and physical properties.
2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Shop primers.
5. Nonshrink grout.

F. Sample Warranties: For special warranties.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panel finishes to include in maintenance manuals.

1.9 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer.

1. Accreditation: Manufacturer's facility accredited according to the International Accreditation Service's AC472, "Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems."
2. Engineering Responsibility: Preparation of comprehensive engineering analysis and Shop Drawings by a professional engineer who is legally qualified to practice in jurisdiction where Project is located.

B. Erector Qualifications: An experienced erector who specializes in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.

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

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, sheets, panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Protect foam-plastic insulation as follows:

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

1.11 FIELD CONDITIONS

- A. Weather Limitations: Proceed with panel installation only when weather conditions permit metal panels to be installed according to manufacturers' written instructions and warranty requirements.

1.12 WARRANTY

- A. Special Warranty on Metal Panel Finishes: Manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 2. Finish Warranty Period: 20 years from date of Substantial Completion.
- B. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that leak or otherwise fail to remain weathertight within specified warranty period.
1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:
1. American Buildings Company; a Nucor company.
 2. Butler Manufacturing Company; a division of BlueScope Buildings North America, Inc.
 3. Ceco Building Systems; an NCI company.
 4. Kirby Building Systems; a Nucor company. Star Building Systems; a division of NCI Building Systems, Inc.
 5. Varco Pruden Buildings; a division of BlueScope Buildings North America, Inc.
- C. Source Limitations: Obtain metal building system components, including primary and secondary framing and metal panel assemblies, from single source from single manufacturer.

2.2 SYSTEM DESCRIPTION

- A. Provide a complete, integrated set of mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior.
- B. Primary-Frame Type:

1. Rigid Clear Span: Solid-member, structural-framing system without interior columns.
- C. End-Wall Framing: Manufacturer's standard, for buildings not required to be expandable, consisting of load-bearing end-wall and corner columns and rafters.
- D. Secondary-Frame Type: Manufacturer's standard purlins and joists and partially inset-framed girts.
- E. Eave Height: As indicated by nominal height on Drawings.
- F. Bay Spacing: As indicated on Drawings.
- G. Roof Slope: As indicated on Drawings.
- H. Roof System: Manufacturer's standard foamed-insulation-core metal roof panels.
 1. Liner Panels: Tapered rib.
- I. Exterior Wall System: Manufacturer's standard foamed-insulation-core metal wall panels.
 1. Liner Panels: Flush profile.

2.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design metal building system.
- B. Structural Performance: Metal building systems shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to procedures in MBMA's "Metal Building Systems Manual."
 1. Design Loads:
 2. Deflection and Drift Limits: Design metal building system assemblies to withstand serviceability design loads without exceeding deflections and drift limits recommended in AISC Steel Design Guide No. 3 "Serviceability Design Considerations for Steel Buildings."
 3. Deflection and Drift Limits: No greater than the following:
 - a. Purlins and Rafters: Vertical deflection of 1/240 of the span.
 - b. Girts: Horizontal deflection of 1/180 of the span.
 - c. Metal Roof Panels: Vertical deflection of 1/240 of the span.
 - d. Metal Wall Panels: Horizontal deflection of 1/180 of the span.
 - e. Design secondary-framing system to accommodate deflection of primary framing and construction tolerances, and to maintain clearances at openings.
 - f. Lateral Drift: Maximum of 1/200 of the building height.
- C. Seismic Performance: Metal building system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

- E. Fire-Resistance Ratings: Where assemblies are indicated to have a fire-resistance rating, provide metal panel assemblies identical to those of assemblies tested for fire resistance per ASTM E 119 or ASTM E 108 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Indicate design designations from UL's "Fire Resistance Directory," FM Global's "Approval Guide," or from the listings of another qualified testing agency.
- F. Fire Propagation Characteristics: Exterior wall assemblies containing foam plastics pass NFPA 285 fire test.
- G. 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 or UL 10C.
1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
- H. Structural Performance for Metal Roof and Wall Panels: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
1. Wind Loads: As indicated on Drawings.
- I. Air Infiltration for Metal Roof Panels: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 1680 at the following test-pressure difference:
1. Test-Pressure Difference: 1.57 lbf/sq. ft..
- J. Water Penetration for Metal Roof Panels: No water penetration when tested according to ASTM E 1646 at the following test-pressure difference:
1. Test-Pressure Difference: 2.86 lbf/sq. ft..
- K. Water Penetration for Metal Wall Panels: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
1. Test-Pressure Difference: 2.86 lbf/sq. ft..
- L. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
1. Uplift Rating: UL 90.
- M. FM Global Listing: Provide metal roof panels and component materials that comply with requirements in FM Global 4471 as part of a panel roofing system and that are listed in FM Global's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.
1. Fire/Windstorm Classification: Class 1A-90.
 2. Hail Resistance: SH.
- N. Solar Reflectance Index: Not less than 29 according to ASTM E 1980.
- O. Energy Star Listing: Roof panels that are listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for steep-slope roof products.

- P. Energy Performance: Provide roof panels according to one of the following when tested according to CRRC-1:
1. Three-year, aged, solar reflectance of not less than 0.55 and emissivity of not less than 0.75.
 2. Three-year, aged, Solar Reflectance Index of not less than 64 when calculated according to ASTM E 1980.
- Q. Thermal Performance for Opaque Elements: Provide the following maximum U-factors and minimum R-values when tested according to ASTM C 1363 or ASTM C 518:
1. Roof:
 - a. U-Factor: 0.025.
 - b. R-Value: 39.
 2. Walls:
 - a. U-Factor: 0.05.
 - b. R-Value: 20.

2.4 STRUCTURAL-STEEL FRAMING

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Structural Steel: Comply with AISC 360, "Specification for Structural Steel Buildings."
- C. Bolted Connections: Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- D. Cold-Formed Steel: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" for design requirements and allowable stresses.
- E. Primary Framing: Manufacturer's standard primary-framing system, designed to withstand required loads and specified requirements. Primary framing includes transverse and lean-to frames; rafters, rake, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing.
1. General: Provide frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly. Provide frame span and spacing indicated.
 - a. Slight variations in span and spacing may be acceptable if necessary to comply with manufacturer's standard, as approved by Architect.
 2. Rigid Clear-Span Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Interior columns are not permitted.
 3. Frame Configuration: Single gable.
 4. Exterior Column: Uniform depth or tapered.
 5. Rafter: Uniform depth or tapered.
- F. End-Wall Framing: Manufacturer's standard primary end-wall framing fabricated for field-bolted assembly to comply with the following:
1. End-Wall and Corner Columns: I-shaped sections fabricated from structural-steel shapes; shop-welded, built-up steel plates; or C-shaped, cold-formed, structural-steel sheet.
 2. End-Wall Rafters: C-shaped, cold-formed, structural-steel sheet; or I-shaped sections fabricated from shop-welded, built-up steel plates or structural-steel shapes.

- G. Secondary Framing: Manufacturer's standard secondary framing, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Unless otherwise indicated, fabricate framing from either cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet, prepainted with coil coating, to comply with the following:
1. Purlins: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; minimum 2-1/2-inch- wide flanges.
 - a. Depth: As needed to comply with system performance requirements.
 2. Girts: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes. Form ends of Z-sections with stiffening lips angled 40 to 50 degrees from flange, with minimum 2-1/2-inch- wide flanges.
 - a. Depth: As required to comply with system performance requirements.
 3. Eave Struts: Unequal-flange, C-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; to provide adequate backup for metal panels.
 4. Flange Bracing: Minimum 2-by-2-by-1/8-inch structural-steel angles or 1-inch- diameter, cold-formed structural tubing to stiffen primary-frame flanges.
 5. Sag Bracing: Minimum 1-by-1-by-1/8-inch structural-steel angles.
 6. Base or Sill Angles: Manufacturer's standard base angle, minimum 3-by-2-inch, fabricated from zinc-coated (galvanized) steel sheet.
 7. Purlin and Girt Clips: Manufacturer's standard clips fabricated from steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.
 8. Framing for Openings: Channel shapes; fabricated from cold-formed, structural-steel sheet or structural-steel shapes. Frame head and jamb of door openings and head, jamb, and sill of other openings.
 9. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.
- H. Bracing: Provide adjustable wind bracing using any method as follows:
1. Rods: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50; or ASTM A 529/A 529M, Grade 50; minimum 1/2-inch- diameter steel; threaded full length or threaded a minimum of 6 inches at each end.
 2. Rigid Portal Frames: Fabricated from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.
- I. Anchor Rods: Headed anchor rods as indicated in Anchor Rod Plan for attachment of metal building to foundation.
- J. Materials:
1. W-Shapes: ASTM A 992/A 992M; ASTM A 572/A 572M, Grade 50 or 55; or ASTM A 529/A 529M, Grade 50 or 55.
 2. Channels, Angles, M-Shapes, and S-Shapes: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 or 55; or ASTM A 529/A 529M, Grade 50 or 55.
 3. Plate and Bar: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 or 55; or ASTM A 529/A 529M, Grade 50 or 55.
 4. Structural-Steel Sheet: Hot-rolled, ASTM A 1011/A 1011M, Structural Steel (SS), Grades 30 through 55, or High-Strength Low-Alloy Steel (HSLAS) or High-Strength Low-Alloy Steel with Improved Formability (HSLAS-F), Grades 45 through 70; or cold-rolled, ASTM A 1008/A 1008M, Structural Steel (SS), Grades 25 through 80, or HSLAS, Grades 45 through 70.
 5. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, SS, Grades 33 through 80, or HSLAS or HSLAS-F, Grades 50 through 80; with G60 coating designation; mill phosphatized.
 6. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

- a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, SS, Grades 33 through 80, or HSLAS or HSLAS-F, Grades 50 through 80; with G90 coating designation.
- b. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, SS, Grade 50 or 80; with Class AZ50 coating.
- 7. Non-High-Strength Bolts, Nuts, and Washers: ASTM A 307, Grade A, carbon-steel, hex-head bolts; ASTM A 563 carbon-steel hex nuts; and ASTM F 844 plain (flat) steel washers.
 - a. Finish: Hot-dip zinc coating, ASTM F 2329, Class C.
- 8. Structural Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563 heavy-hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
 - a. Finish: Hot-dip zinc coating, ASTM F 2329, Class C.
- 9. High-Strength Bolts, Nuts, and Washers: ASTM A 490, Type 1, heavy-hex steel structural bolts or tension-control, bolt-nut-washer assemblies with spline ends; ASTM A 563 heavy-hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers, plain.
- 10. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex-head steel structural bolts with spline ends.
 - a. Finish: Mechanically deposited zinc coating, ASTM B 695, Class 50
- 11. Unheaded Anchor Rods: ASTM F 1554, Grade 36
 - a. Configuration: Straight.
 - b. Nuts: ASTM A 563 heavy hex carbon steel.
 - c. Plate Washers: ASTM A 36/A 36M carbon steel.
 - d. Washers: ASTM F 436 hardened carbon steel.
 - e. Finish: Hot-dip zinc coating, ASTM F 2329, Class C
- 12. Headed Anchor Rods: ASTM F 1554, Grade 36.
 - a. Configuration: Straight.
 - b. Nuts: ASTM A 563 heavy-hex carbon steel.
 - c. Plate Washers: ASTM A 36/A 36M carbon steel.
 - d. Washers: ASTM F 436 hardened carbon steel.
 - e. Finish: Hot-dip zinc coating, ASTM F 2329, Class C
- 13. Threaded Rods: ASTM A 193/A 193M
 - a. Nuts: ASTM A 563 heavy-hex carbon steel.
 - b. Washers: ASTM F 436 hardened carbon steel.
 - c. Finish: Plain

K. Finish: Factory primed. Apply specified primer immediately after cleaning and pretreating.

- 1. Clean and prepare in accordance with SSPC-SP2.
- 2. Coat with manufacturer's standard primer. Apply primer to primary and secondary framing to a minimum dry film thickness of 1 mil.
 - a. Prime secondary framing formed from uncoated steel sheet to a minimum dry film thickness of 0.5 mil on each side.

2.5 FOAMED-INSULATION-CORE METAL ROOF PANELS

- A. Standing seam –foamed insulation Core Metal Roof Panels: Fabricated panels formed with 2" vertical ribs at maximum 36" apart and intermediate stiffening ribs as required symmetrically spaced between major ribs; designed to be installed by attachment clip between adjacent panels and folding standing seam of adjacent panels together.

1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.030-inch nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Exterior Finish: Two-coat fluoropolymer.
 - b. Color: As selected by Architect from manufacturer's full range.
2. Major-Rib Spacing: 36 inches o.c.
3. Panel Coverage: 36 inches.
4. Continuous panel coverage from eave to ridge.
5. Panel Thermal Resistance Value (R-Value): 39
6. Insulation Core: Modified polyisocyanurate or polyurethane foam using a non-CFC blowing agent, foamed-in-place or board type, with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively.
 - a. Closed-Cell Content: 90 percent when tested according to ASTM D 6226.
 - b. Density: 2.0 to 2.6 lb/cu. ft. (32 to 42 kg/cu. m) when tested according to ASTM D 1622.
 - c. Compressive Strength: Minimum 20 psi (140 kPa) when tested according to ASTM D 1621.
 - d. Shear Strength: 26 psi (179 kPa) when tested according to ASTM C 273/C 273M.
7. Fire-Test-Response Characteristics: Class A according to ASTM E 108.
8. Surface-Burning Characteristics: Flame-spread index of 25 or less and a smoke-developed index of 450 or less, per ASTM E 84.

B. Finishes:

1. Exposed Coil-Coated Finish:
 - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

C. Manufacturers Basis of Design: Provide product listed below or metal building manufacturer's standard panel matching requirements:

1. CFR Roof Panel; by MetlSpan
2. VersaPanel, by Centria

2.6 FOAMED-INSULATION-CORE METAL WALL PANELS

A. Concealed-Fastener, Foamed-Insulation-Core Metal Wall Panels : Formed with tongue-and-groove panel edges; designed for sequential installation by interlocking panel edges and mechanically attaching panels to supports using concealed clips or fasteners.

1. Panel Thermal-Resistance Value (R-Value): 20.
2. Facing Material: Fabricate panel with exterior and interior facings of same material and thickness. Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, [0.018-inch] [0.024-inch] [0.030-inch] nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Exterior Surface: Shallow ribs.
 - b. Exterior Finish: Two-coat fluoropolymer.
 - c. Color: As selected by Architect from manufacturer's full range.
3. Panel Coverage: 36 inches nominal.

4. Continuous panel coverage from base to top of wall.
5. Panel Thickness: 3 inches.
6. Insulation Core: Modified polyisocyanurate or polyurethane foam using a non-CFC blowing agent, foamed-in-place or board type, with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively.
 - a. Closed-Cell Content: 90 percent when tested according to ASTM D 6226.
 - b. Density: 2.0 to 2.6 lb/cu. ft. when tested according to ASTM D 1622.
 - c. Compressive Strength: Minimum 20 psi when tested according to ASTM D 1621.
 - d. Shear Strength: 26 psi when tested according to ASTM C 273/C 273M.
7. Fire-Test-Response Characteristics: Class A according to ASTM E 108.
8. Surface-Burning Characteristics: Flame-spread index of 25 or less and a smoke-developed index of 450 or less, per ASTM E 84.

B. Finishes:

1. Exposed Coil-Coated Finish:
 - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

2.7 METAL SOFFIT PANELS

- A. General: Provide factory-formed metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.
- B. Concealed-Fastener, Flush-Profile, Metal Soffit Panels : Formed with vertical panel edges and flush surface; with flush joint between panels; with 1-inch- wide flange for attaching interior finish; designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps.
 1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, [0.024-inch] [0.030-inch] nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Exterior Finish: Fluoropolymer.
 - b. Color: As selected by Architect from manufacturer's full range.
 2. Panel Coverage: 16 inches.
 3. Panel Height: 1 inch.

2.8 PERSONNEL DOORS AND FRAMES

- A. Swinging Personnel Doors and Frames: As specified in Section 081113 "Hollow Metal Doors and Frames."

2.9 WINDOWS

- A. Aluminum Windows: As specified in Section 084113 "Aluminum-Framed Entrances and Storefronts."

- B. Glazing: Comply with requirements specified in Section 088000 "Glazing."

2.10 ACCESSORIES

- A. General: Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.
1. Form exposed sheet metal accessories that are without excessive oil-canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
- B. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including copings, fasciae, corner units, ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.
1. Closures: Provide closures at eaves and ridges, fabricated of same material as metal roof panels.
 2. Cleats: Manufacturer's standard, mechanically seamed cleats formed from steel sheet.
 3. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 4. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
 5. Thermal Spacer Blocks: Where metal panels attach directly to purlins, provide thermal spacer blocks of thickness required to provide 1-inch standoff; fabricated from extruded polystyrene.
- C. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including copings, fasciae, mullions, sills, corner units, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels unless otherwise indicated.
1. Closures: Provide closures at eaves and rakes, fabricated of same material as metal wall panels.
 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- D. Flashing and Trim: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, prepainted with coil coating; finished to match adjacent metal panels.
1. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers.
 2. Opening Trim: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, [0.018-inch] [0.030-inch] nominal uncoated steel thickness, prepainted with coil coating. Trim head and jamb of door openings, and head, jamb, and sill of other openings.
- E. Gutters: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, prepainted with coil coating; finished to match roof fascia and rake trim. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- long sections, sized according to SMACNA's "Architectural Sheet Metal Manual."

1. Gutter Supports: Fabricated from same material and finish as gutters.
2. Strainers: Bronze, copper, or aluminum wire ball type at outlets.

F. Downspouts: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, prepainted with coil coating; finished to match metal wall panels. Fabricate in minimum 10-foot- long sections, complete with formed elbows and offsets.

1. Mounting Straps: Fabricated from same material and finish as gutters.

G. Materials:

1. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide fasteners with heads matching color of materials being fastened by means of plastic caps or factory-applied coating.
 - a. Fasteners for Metal Roof Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with a stainless-steel cap or zinc-aluminum-alloy head and EPDM sealing washer.
 - b. Fasteners for Metal Roof Panels: Self-drilling, Type 410 stainless steel or self-tapping, Type 304 stainless-steel or zinc-alloy-steel hex washer head, with EPDM washer under heads of fasteners bearing on weather side of metal panels.
 - c. Fasteners for Metal Wall Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws. EPDM sealing washers bearing on weather side of metal panels where exposed fasteners are used.
 - d. Fasteners for Metal Wall Panels: Self-drilling, Type 410 stainless steel or self-tapping, Type 304 stainless-steel or zinc-alloy-steel hex washer head. EPDM sealing washers bearing on weather side of metal panels where exposed fasteners are used.
 - e. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
 - f. Blind Fasteners: High-strength aluminum or stainless-steel rivets.
2. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
3. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
4. Metal Panel Sealants:
 - a. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene-compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape of manufacturer's standard size.
 - b. Joint Sealant: ASTM C 920; one part elastomeric polyurethane or polysulfide; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended by metal building system manufacturer.

2.11 FABRICATION

A. General: Design components and field connections required for erection to permit easy assembly.

1. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
2. Fabricate structural framing to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Members shall be free of cracks, tears, and ruptures.

- B. Tolerances: Comply with MBMA's "Metal Building Systems Manual" for fabrication and erection tolerances.
- C. Primary Framing: Shop fabricate framing components to indicated size and section, with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.
 - 1. Make shop connections by welding or by using high-strength bolts.
 - 2. Join flanges to webs of built-up members by a continuous, submerged arc-welding process.
 - 3. Brace compression flange of primary framing with steel angles or cold-formed structural tubing between frame web and purlin web or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
 - 4. Weld clips to frames for attaching secondary framing if applicable, or punch for bolts.
 - 5. Shop Priming: Prepare surfaces for shop priming according to SSPC-SP 2. Shop prime primary framing with specified primer after fabrication.
- D. Secondary Framing: Shop fabricate framing components to indicated size and section by roll forming or break forming, with baseplates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.
 - 1. Make shop connections by welding or by using non-high-strength bolts.
 - 2. Shop Priming: Prepare uncoated surfaces for shop priming according to SSPC-SP 2. Shop prime uncoated secondary framing with specified primer after fabrication.
- E. Metal Panels: Fabricate and finish metal panels at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.
 - 1. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of metal panel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with erector present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Before erection proceeds, survey elevations and locations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments to receive structural framing, with erector present, for compliance with requirements and metal building system manufacturer's tolerances.
 - 1. Engage land surveyor to perform surveying.
- C. Proceed with erection only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition.

- B. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION OF STRUCTURAL FRAMING

- A. Erect metal building system according to manufacturer's written instructions and drawings.
- B. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.
- C. Set structural framing accurately in locations and to elevations indicated, according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.
- D. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 3. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- E. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure will be completed and in service.
- F. Primary Framing and End Walls: Erect framing level, plumb, rigid, secure, and true to line. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist-cure grout for not less than seven days after placement.
 - 1. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt type and joint type specified.
 - a. Joint Type: Snug tightened or pretensioned as required by manufacturer.
- G. Secondary Framing: Erect framing level, plumb, rigid, secure, and true to line. Field bolt secondary framing to clips attached to primary framing.
 - 1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.
 - 2. Locate and space wall girts to suit openings such as doors and windows.
 - 3. Provide supplemental framing at entire perimeter of openings, including doors, windows, louvers, ventilators, and other penetrations of roof and walls.
- H. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.
 - 1. Tighten rod and cable bracing to avoid sag.
 - 2. Locate interior end-bay bracing only where indicated.

- I. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.
- J. Erection Tolerances: Maintain erection tolerances of structural framing within AISC 303.

3.4 METAL PANEL INSTALLATION, GENERAL

- A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Examination: Examine primary and secondary framing to verify that structural-panel support members and anchorages have been installed within alignment tolerances required by manufacturer.
 - 1. Examine roughing-in for components and systems penetrating metal panels, to verify actual locations of penetrations relative to seams before metal panel installation.
- D. General: Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Field cut metal panels as required for doors, windows, and other openings. Cut openings as small as possible, neatly to size required, and without damage to adjacent metal panel finishes.
 - a. Field cutting of metal panels by torch is not permitted unless approved in writing by manufacturer.
 - 2. Install metal panels perpendicular to structural supports unless otherwise indicated.
 - 3. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.
 - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 - 5. Locate metal panel splices over structural supports with end laps in alignment.
 - 6. Lap metal flashing over metal panels to allow moisture to run over and off the material.
- E. Lap-Seam Metal Panels: Install screw fasteners using power tools with controlled torque adjusted to compress EPDM washers tightly without damage to washers, screw threads, or metal panels. Install screws in predrilled holes.
 - 1. Arrange and nest side-lap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply metal panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
- F. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.
- G. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants indicated; or, if not indicated, provide types recommended by metal panel manufacturer.

1. Seal metal panel end laps with double beads of tape or sealant the full width of panel. Seal side joints where recommended by metal panel manufacturer.
2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

3.5 METAL ROOF PANEL INSTALLATION

- A. General: Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.
1. Install ridge caps as metal roof panel work proceeds.
 2. Flash and seal metal roof panels with weather closures at eaves and rakes. Fasten with self-tapping screws.
- B. Standing-Seam Metal Roof Panels: Fasten metal roof panels with concealed clip sized for panel thickness and fasteners to structure, at location and spacing recommended by manufacturer.
1. Provide metal-backed sealing washers under heads of exposed fasteners bearing on weather side of metal roof panels.
 2. Provide sealant tape at lapped joints of metal roof panels and between panels and protruding equipment, vents, and accessories.
 3. Apply a continuous ribbon of sealant tape to weather-side surface of fastenings on top edge of male rib and on side laps of nesting-type metal panels, on side laps of ribbed or fluted metal panels, and elsewhere as needed to make metal panels weatherproof to driving rains.
 4. Apply a continuous ribbon of sealant in the panels interior face groove
 5. At metal panel splices, nest panels with minimum 6-inch end lap, sealed with butyl-rubber sealant and fastened together by interlocking clamping plates.
 6. Fold standing seam of adjoining panels into clip with automatic seaming machine.
- C. Metal Fascia Panels: Align bottom of metal panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws. Flash and seal metal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.
- D. Metal Roof Panel Installation Tolerances: Shim and align metal roof panels within installed tolerance of 1/4 inch in 20 feet on slope and location lines and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.6 METAL WALL PANEL INSTALLATION

- A. General: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts, extending full height of building, unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.
1. Flashing and seal metal wall panels with weather closures at base and top of panel and other corners and joints between panels.
- B. Fasten metal wall panels with concealed clip sized for panel thickness and fastened back to girts or metal wall studs at spacing recommended by manufacturer.
1. Panels edges fitted to join together with tongue and groove connections. Fully engage tongue and groove of adjacent insulated metal wall panel.
 2. Install clips with self-tapping fasteners.
 3. Provide either factory applied sealant at all panel joints or field install joint sealant in both interior and exterior groove of the panel's female edge as a vapor seal.

4. Shim or otherwise plumb substrates receiving metal panels. Inspect substrates and correct substrates out of manufacturers recommended tolerance.
5. Install flashing and trim as metal wall panel proceeds.

C. Install exposed trim and flashing pieces matching face of insulated metal wall panels.

1. Fabricate trim pieces with concealed clips and fasteners. When concealed fasteners are not possible, install trim pieces with exposed fasteners or rivets matching panel face color.

3.7 METAL SOFFIT PANEL INSTALLATION

A. Provide metal soffit panels the full width of soffits. Install panels perpendicular to support framing.

B. Flash and seal metal soffit panels with weather closures where panels meet walls and at perimeter of all openings.

3.8 DOOR AND FRAME INSTALLATION

A. General: Install doors and frames plumb, rigid, properly aligned, and securely fastened in place according to manufacturers' written instructions. Coordinate installation with wall flashings and other components. Seal perimeter of each door frame with elastomeric sealant used for metal wall panels.

B. Personnel Doors and Frames: Install doors and frames according to NAAMM-HMMA 840. Fit non-fire-rated doors accurately in their respective frames, with the following clearances:

1. Between Doors and Frames at Jambs and Head: 1/8 inch.
2. Between Edges of Pairs of Doors: 1/8 inch.
3. At Door Sills with Threshold: 3/8 inch.
4. At Door Sills without Threshold: 3/4 inch.
5. At fire-rated openings, install frames according to, and doors with clearances specified in, NFPA 80.

C. Field Glazing: Comply with installation requirements in Section 088000 "Glazing."

D. Door Hardware:

1. Install surface-mounted items after finishes have been completed at heights indicated in DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
3. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
4. Set thresholds for exterior doors in full bed of sealant complying with requirements for concealed mastics specified in Section 079200 "Joint Sealants."

3.9 WINDOW INSTALLATION

A. General: Install windows plumb, rigid, properly aligned, without warp or rack of frames or sash, and securely fasten in place according to manufacturer's written instructions. Coordinate installation with wall flashings and other components. Seal perimeter of each window frame with elastomeric sealant used for metal wall panels.

1. Separate dissimilar materials from sources of corrosion or electrolytic action at points of contact with other materials by complying with requirements specified in AAMA/WDMA/CSA 101/I.S.2/A440.
- B. Set sill members in bed of sealant or with gaskets, for weathertight construction.
- C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.

3.10 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
 1. Install components required for a complete metal roof panel assembly, including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 2. Install components for a complete metal wall panel assembly, including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 3. Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
 1. Install exposed flashing and trim that is without excessive oil-canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
- C. Gutters: Join sections with riveted-and-soldered or lapped-and-sealed joints. Attach gutters to eave with gutter hangers spaced as required for gutter size, but not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- D. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.
 1. Provide elbows at base of downspouts to direct water away from building.
 2. Tie downspouts to underground drainage system indicated.

3.11 FIELD QUALITY CONTROL

- A. Product will be considered defective if it does not pass tests and inspections.
- B. Prepare test and inspection reports.

3.12 ADJUSTING

- A. Doors: After completing installation, test and adjust doors to operate easily, free of warp, twist, or distortion.
- B. Door Hardware: Adjust and check each operating item of door hardware and each door to ensure proper operation and function of every unit. Replace units that cannot be adjusted to operate as intended.
- C. Windows: Adjust operating sashes and ventilators, screens, hardware, and accessories for a tight fit at contact points and at weather stripping to ensure smooth operation and weathertight closure. Lubricate hardware and moving parts.
- D. : After completing installation, including work by other trades, lubricate, test, and adjust units to operate easily, free of warp, twist, or distortion as needed to provide fully functioning units.
 - 1. Adjust louver blades to be weathertight when in closed position.

3.13 CLEANING AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780/A 780M and manufacturer's written instructions.
- B. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- C. Touchup Painting: After erection, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted structural framing, bearing plates, and accessories.
 - 1. Clean and prepare surfaces by SSPC-SP 2, "Hand Tool Cleaning," or by SSPC-SP 3, "Power Tool Cleaning."
 - 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.
- D. Touchup Painting: Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- E. Metal Panels: Remove temporary protective coverings and strippable films, if any, as metal panels are installed. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
 - 1. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.
- F. Doors and Frames: Immediately after installation, sand rusted or damaged areas of prime coat until smooth and apply touchup of compatible air-drying primer.
 - 1. Immediately before final inspection, remove protective wrappings from doors and frames.

END OF SECTION 133419

DIVISION 21 – FIRE/SPRINKLER

SECTION 210500 - AUTOMATIC SPRINKLER

SECTION 210500 – AUTOMATIC SPRINKLER

PART 1 - GENERAL

1.1 SCOPE

- A. The fire protection work covered by this section consists of furnishing all labor, materials, tools, equipment, services, and supervision required to install, test, and place in service complete wet pipe fire sprinkler system for the Missouri Air National Guard. Work shall also include installation of the backflow prevention assembly, underground lead-in connections and post indicating valve.
- B. The work shall be in accordance with NFPA 13 (2010 Edition), NFPA 24 (2010 Edition) and Unified Facilities Criteria (UFC) 3-600-01, 26 September 2006, Change 1, 14 July 2009) ANG ETL 01-1-1 (Revised March 2004) and shall be completed as indicated on the drawings and specified herein.
- C. The design drawings associated with these specifications are not shop drawings but serve as a reference for basic system configuration. The Contractor is to provide a complete shop drawing submittal, including all information required by NFPA 13. Shop drawing submittals shall indicate all pipe lengths, elevations and offsets as coordinated with all trades.
- D. All work shall be executed and inspected in accordance with contract specifications, ANG ETL, UFC requirements and all state codes, rules, ordinances, and regulations pertaining to the work involved. Should any change in the contract drawings or specifications be required to conform to such requirements, the Contracting Officer shall be notified at the time of bid submittal.
- E. After entering into the contract, the Contractor shall be held responsible for the completion of all work necessary for a complete and approved installation without extra expense to the Owner.
- F. The Contractor shall prepare any supplementary detailed diagrams or drawings, which may be required by the state authority, local Authority Having Jurisdiction (AHJ) or Contracting Officer .
- G. Any deviations from the requirements of this specification must be acknowledged in writing with the supplier's bid offer.

1.2 SYSTEM DESCRIPTION

- A. Complete, integrated, and operating fire sprinkler system(s) shall be installed throughout the 139th Missouri Air National Guard Security Forces Admin and Storage Building located in St. Joseph, Missouri as specified herein and as shown on the drawings.
- B. System shall include, but not be limited to: main control valves, post indicating valve, "shot-gun" risers, g fire department connection, backflow prevention assembly, underground lead-in with connection to water supply if required, inspector's test connection, piping, sprinklers, hangers, flow indicators, supervisory switches for all sprinkler control valves and all accessories required to furnish a complete and operational systems.
- C. A 6 inch fire department connection with check valve shall be provided with an automatic ball drip piped to the exterior of the building and readily accessible for inspection, operation, testing, maintenance, and removal of equipment contained within.

1.3 SYSTEM DESIGN

- A. The Contractor is required to perform hydraulic calculations as required by the UFC. The design area of operation for hydraulic calculations shall be the hydraulically remote 3000 square feet.
- B. The fire protection Contractor may, if approved by the Contracting Officer , redesign and recalculate the indicated system(s) or areas of systems to comply with these specifications, the drawings and criteria provided by the Contracting Officer .
- C. Where details of design, fabrication, and erection are not shown on the drawings or specified in this specification, the omitted details shall be provided on contractors installation drawings in accordance with the requirements of NFPA 13 and their appendices, the UFC and ANG ETL.
- D. No changes in pipe size, pipe arrangement, or addition of sprinklers shall be made in the field without prior approval of the Contractor's revised hydraulic calculations by the Contracting Officer .
- E. Unless specifically approved by the Contracting Officer , no piping shall be installed exposed except in unfinished spaces.

1.4 SUBMITTALS

A. General

- 1 The Contractor shall submit nine sets of shop drawings, calculations, as-built drawings and product data to the Contracting Officer for approval.
- 2 No work, fabrication, or installation may proceed without the Contractor having received written approval from the Contracting Officer , Owner's insuring party and local Authority Having Jurisdiction, as applicable.
- 3 Any changes to or deviations from approved drawings require re-submittal and written approval from the Contracting Officer .

B. Shop/Working Drawings. The Contractor shall prepare and submit, prior to the commencement of any work (fabrication, installation, etc.), shop/working drawings as follows:

- 1 All Shop/Working Drawings and Material and Equipment Data shall be submitted to the Contracting Officer 100% complete and at one time.
- 2 The minimum scale shall be 1/8 inch equals 1 foot 0 inches, clearly indicating the essential details including all specialties, concealed spaces, ventilators, and possible obstructions. The Contracting Officer will provide an electronic copy of the design drawings to the Contractor. Drawings shall be developed in Auto Cad Release 2000 or greater.
- 3 Drawings shall clearly indicate all information required by NFPA 13 for sprinkler systems.

C. Hydraulic Calculations.

- 1 Hydraulic Calculations are the responsibility of the Contractor. Minimum pipe sizing for all arm-overs to single sprinklers shall be 1 inch.
- 2 Hydraulic calculations shall be prepared on form sheets that include a summary sheet, detailed work sheet, and a water supply versus demand graph.
- 3 Calculations submitted shall provide applicable data specified in NFPA 13 and as required by the Unified Facilities Criteria (UFC).

- 4 The minimum design criteria shall be 0.20 gpm per square foot over the hydraulically remote 3,000 square foot area for Hazardous Storage Area.
- 5 Light hazard areas minimum design criteria shall be 0.10 gpm per square foot over the hydraulically remote 3000 square foot.
- 6 Ordinary hazard areas minimum design criteria shall be 0.15 gpm per square foot over the hydraulically remote 3000 square foot.
- 7 The outside hose of 500 gpm shall be added to the total fire sprinkler system supply requirement at the point of the new fire sprinkler system connection to the existing water supply.

D. Material and Equipment Data

- 1 All Materials and Equipment Data shall be submitted to the Contracting Officer 100% complete and at one time.
- 2 The Contractor shall submit to the Contracting Officer , prior to the commencement of any work (fabrication, installation, etc.), the name of the manufacturer and the type or model of each principal item of equipment or material proposed for installation. To accomplish this, it is acceptable to provide the manufacturer's descriptive, illustrated literature of all equipment, materials and devices.
- 3 The submittal shall provide positive indication of the specific size and description of the equipment, material or device used on this project. In other words, the data should be site specific, deleting any reference to options that do not apply to the project.

- E. As-Built Drawings. Upon completion of the work, the Contractor shall revise all drawings to agree with the construction as actually accomplished and shall stamp such drawings "As-Built." One mylar reproducible copy and one electronic copy in Auto Cad, Release 2000 or greater, shall also be provided. The as-built/record drawings shall have an accuracy of $\pm 0'-6"$.

F. Operations and Maintenance Manuals

- 1 The Contractor shall furnish operating instructions outlining the step-by-step procedures required for system start-up, operation, testing and take down procedures. The instructions shall include the manufacturer's name, model number, catalog cuts, diagrams, drawings, parts list and descriptive data covering the proper operation and testing of the system(s).
- 2 The Contractor shall furnish maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. The instructions shall reflect as-built conditions and include simplified diagrams for the system.
- 3 After approval of the shop drawings and no later than field acceptance testing, the Contractor shall provide a list of recommended spare parts and supplies, a current unit price and a source of supply.

G. Posted Instructions

- 1 Framed instructions under glass, showing the schematic layout of the entire system, shall be posted adjacent to the system riser.
- 2 Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely operating and shutting down the system shall be prepared in typed form and posted beside schematic drawings of the system(s).

- 3 Proposed drawings/diagrams, instructions, and other sheets shall be posted before acceptance testing of the system(s).

H. Certification and Field Test Reports

- 1 Hydrostatic reports shall be completed in accordance with Section 4 of Part III of this specification, NFPA 13 and NFPA 24. Hydrostatic testing shall be conducted at 200 psi for a period of two hours. **NOTE:** The Contractor shall utilize industry-accepted test reports (NFPA format) that provide sufficient detail on system components, tests completed, data collected and test results.
- 2 At least two weeks prior to requesting a final acceptance test of the fire protection system, the Contractor shall prepare and submit pre-operational test procedures that detail what is to be tested, how the tests are to be conducted and what acceptance (pass/fail) parameters for the various tests and test equipment will be required. The test report shall provide a table indicating final valve position and optimum settings on relief valves, pressure gauges, etc.
- 3 Upon completion of pre-operational testing, three (3) copies of the test reports shall be submitted in booklet form detailing the tests performed, data collected, adjustments made, and any other necessary actions required to prove compliance with the specified performance criteria. Each test report shall indicate the final position of all valves and set-points on pressure gauges and relief valves on wet pipe systems.
- 4 Tests shall be completed in accordance with Part III, Section 4 in this Specification. The Contractor is responsible for providing all test equipment necessary in the performance of field acceptance testing.
- 5 The Contractor and the Owner's Representative shall sign off on all test reports.

1.5 QUALITY ASSURANCE

- A. All materials and equipment furnished and installed under this section shall be new and currently listed for fire protection use by latest edition of the Underwriters Laboratory (UL) or approved by Factory Mutual (FM) for the intended application, except as otherwise specified herein.
- B. Development of shop drawings and hydraulic calculations shall be supervised by a NICET Level III or IV technician certified in automatic sprinkler system design or a registered professional engineer competent in sprinkler system design. Shop drawings shall be reviewed and sealed by the NICET Level III or IV technician. Shop drawing preparation shall be performed by a minimum NICET Level II technician.
- C. The completion of this work shall be done by a qualified responsible contractor recognized as being fully experienced in the installation of sprinkler systems in military facilities. The Contractor shall be licensed in the State of Missouri. The Contractor shall also be capable of demonstrating in writing for advance approval, 5 years of automatic sprinkler system installation experience.
- D. The Contractor shall notify the Contracting Officer before any significant changes are made to the original design.
- E. All work shall be performed by competent workers skilled in the installation of automatic sprinkler systems.
- F. All work shall be done in strict accordance with NFPA 13 ANG ETL, UFC and NFPA 24 and their appendices, and other applicable federal, state, and local codes and ordinances, except as otherwise indicated on the drawings or specified herein.

- G. Before installation, the Contractor shall submit to the Contracting Officer , in writing, evidence of experience and qualifications specified herein.

1.6 MAINTENANCE AND WARRANTY SERVICE

- A. Furnish service and maintenance of the fire protection system installed under the provision of this section for a period of one (1) year from the Date of Acceptance by the Owner/Contracting Officer . The maintenance for the first year, including the quarterly and annual testing and maintenance requirements as required by NFPA 25 (2010 Edition) shall be performed by the Contractor. Any required testing and maintenance cost for this maintenance and testing of the system shall be at no extra cost to the Owner and shall be included as part of this contract.

PART 2 - PRODUCTS AND MATERIALS

2.1 GENERAL

- A. Material and equipment shall be as specified or as shown and shall be listed for fire protection use and suitable for the service intended. Materials shall be new and unused.
- B. All materials and equipment furnished and installed under this section shall be listed for fire protection use by Underwriters' Laboratories, Inc., and/or approved by Factory Mutual Engineering Corporation, except as otherwise specified herein.
- C. When two or more units of the same class of equipment are required, they shall be products from a single manufacturer.
- D. All material and equipment necessary to meet the requirements of these codes shall be provided regardless of whether each item or device is specifically mentioned in this section or shown on the drawings.

2.2 DELIVERY, STORAGE AND HANDLING

- A. Accept sprinkler components at job site in factory packing, inspect for damage, and comply with manufacturer's rigging and installation instructions.
- B. Protect all piping, valves and associated components from physical damage, including effects of weather, water and construction debris.
- C. Provide temporary inlet and outlet caps, maintain these protective caps in place until being installed or connected.

2.3 PIPE AND FITTINGS

- A. Aboveground Pipe
 - 1 Pipe used shall not be subject to a working pressure in excess of 25 percent of the hydrostatic pressure test required by ASTM A795, A53, or A135, as applicable.
 - 2 All piping shall be Schedule 40 piping.
- B. Exposed Exterior Drain Piping

- 1 All drain piping and fittings on building exterior, and 6 inches inside building shall be galvanized, Schedule 40 piping.

C. Underground Pipe

- 1 Lead-in connection shall be Ductile Iron or approved equal.
- 2 Pipe shall be designed to withstand a system working pressure of not less than 175 psi.
- 3 Piping shall be listed for fire protection service and comply with the AWWA standards in NFPA 13, where applicable. Lead-in connection shall be ductile iron or approved equal from 5 feet outside building to backflow prevention assembly.

D. Joints: Joints shall conform to NFPA 13.

- 1 Shop welded joints will be permitted.
- 2 Roll-grooved pipe and fittings shall be prepared in accordance with manufacturer's latest published specification for the pipe material, wall thickness, and size.
- 3 Threaded joints will be permitted on Schedule 40 piping only.
- 4 Mechanical grooved pipe joints shall conform to AWWA C606. Joints shall be made using a UL listed or FM approved combination of fittings, gaskets, and grooves. Rolled pipe grooves shall be dimensionally compatible with the fittings.
- 5 Cut groove piping and fittings are not permitted.
- 6 All 2 inch piping and smaller shall be threaded.
- 7 The use of strap on mechanical type tees are strictly prohibited from use.
- 8 The use of uni-flange adapters is strictly prohibited.

E. Fittings: Fittings for piping shall be of a type specifically approved for use in sprinkler systems.

F. The use of mechanical tee type fittings shall not be permitted.

G. Reducers: Reductions in pipe shall be made with one-piece reducing fittings.

H. Bushings: Bushings will not be acceptable.

I. Hangers have not been shown on the design drawings and are the responsibility of the Contractor.

J. All hangers and supports and seismic bracing shall be provided in accordance with provisions of NFPA 13, ANG ETL and the UFC.

2.4 PIPE SLEEVES

A. All penetrations through concrete block walls or concrete floor/ceilings shall be core drilled.

B. Where pipes pass through fire walls, fire partitions, or rated floors, a qualified fire stopping material shall be provided. The Contractor shall submit to the Contracting Officer for approval, supporting documentation that the proposed fire stopping material and the detail indicating the installation requirements of the fire stopping assembly is UL Listed or FM approved for the type of penetration and required fire rating.

C. A water tight penetration sealant shall be used to seal all penetrations that are in walls or floor/ceilings that are not fire walls, fire partitions, or rated floors.

2.5 VALVES

A. General:

- 1 Utilize valves that allow moving parts to be changed out without removing the valve from the installed position.
- 2 Dry pipe valve shall be capable of external resetting.
- 3 General Purpose Type: General purpose valves shall be OS&Y valves of an FM approved or UL listed type.
- 4 All new control and isolation valves shall be electronically supervised by the fire alarm control panel as Class A circuits. All tamper switches are to be provided by the sprinkler contractor.
- 5 Check valves shall be an FM approved and UL listed iron body bronze trimmed swing check.
- 6 Post indicating valve shall be provided and installed at a location determined by the owner and shall have a weather proof tamper switch that is monitored as a Class A circuit by the new fire alarm control panel.

2.6 SPRINKLERS

- A. Sprinklers shall conform to the latest edition of the UL Fire Protection Equipment Directory for the required application and as shown on the drawings.
- B. Clearances between deflectors and ceiling, roof decking, roof joists, electric or heating equipment, or other obstructions shall be in accordance with NFPA 13.
- C. Sprinkler temperatures shall be Ordinary Temperature classification and in accordance with NFPA 13 (2007) for high ambient temperature areas.
- D. Sprinklers shall be of the following type:
 - 1 Standard Spray Quick Response Upright; K = 5.6; Brass.
 - 2 Standard Spray Quick Response Pendent; K = 5.6; White Semi-Recessed.

2.7 SYSTEM SPECIALTIES

- A. Waterflow Indicators
 - 1 Vane type waterflow switches shall be Potter Model VSR-F or equivalent.
 - 2 Pressure switches shall be Potter Model PS10A or equivalent.
 - 3 Switches shall be provided with a ½ -in. NPT.
 - 4 Switches shall be actuated by any flow of water to or in excess of the discharge from one sprinkler.
 - 5 Switches shall have a maximum service pressure rating of 250 psi and shall be factory adjusted to operate on pressure increase at 6 ± 1 psi.
- B. Tamper Switches:
 - 1 Potter Model OSYSU-1 or equivalent.
- C. Supervisory Air Pressure Switch:
 - 1 Potter Model HCSB or equivalent.
- D. Spare Sprinklers, Sprinkler Cabinet and Wrench:
 - 1 Provide steel, baked red enameled, sprinkler box with capacity to store 10 sprinklers and wrench sized to sprinklers. In all cases: sprinkler box capacity must equal or exceed the number of spare sprinklers required. There shall be minimum one sprinkler cabinet at each riser manifold location.

- 2 For each style and temperature range required, furnish additional sprinklers, amounting to 1 unit for every 100 installed units, but not less than 5 units each.

E. Backflow Prevention Assembly

- 1 Backflow preventer shall be Wilkins Model 350, or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

A. SPRINKLER SYSTEMS:

- 1 Provide a placard permanently attached to the system(s) riser indicating the hydraulic design details as required by NFPA 13.
- 2 Clearances between deflectors and ceiling, roof decking, roof joists, electric or heating equipment, or other obstructions shall be in accordance with NFPA 13.
- 3 Install sight glass in the inspector's test connection(s).
- 4 Route drains to locations referenced on plans. Coordinate with Owner for drain location. Drains must be capable of handling full discharge under normal system pressure. The use of floor drains is not permitted.
- 5 All sprinklers must be of the same manufacturer and model designation.
- 6 Replace any painted or paint spotted sprinklers.
- 7 Dry-Pipe sprinkler system piping shall be installed to drain to dry-pipe main drain.
- 8 All piping shall be installed such that no more than 5 gallons capacity is trapped at any one location. If auxiliary drains are required it shall be approved by the Contracting Officer prior to installation.
- 9 All piping shall be installed as tight to building structure as possible throughout the building.

3.2 FABRICATION AND INSTALLATION:

A. Piping:

- 1 Torch cutting and welding will not be permitted as a means of modifying or repairing sprinkler systems.
- 2 Welding shall be done in strict compliance with ASME Boiler and Pressure Vessel Code, Section IX.
- 3 No piping shall be installed to obstruct the removal or access to equipment for maintenance or access.

B. Supports:

- 1 All supports and hangers shall be in accordance with NFPA 13 and the UFC.
- 2 Support risers and valve headers as required by code.
- 3 No piping shall be supported from bottom cord of bar joists.

C. Valves and Accessories:

- 1 Install indicating control valves as shown on drawings.
- 2 Install valve tamper supervision switches on indicating control/zone valves and they shall be monitored by the new fire alarm control panel.

D. Drain and Test Connections:

- 1 Provisions shall be provided to properly drain all parts of the system(s).
- 2 System main drains, test drains, and auxiliary drains shall be in accordance with applicable sections of NFPA 13.

- 3 Inspector test connections for systems shall be restricted orifice and equipped with a site glass.
- 4 Install main drain(s) and drain piping at low points of sprinkler piping.
- 5 A connection for the forward flow requirements of the backflow prevention assembly shall be provided with the pipe size as indicated on the drawings.

3.3 IDENTIFICATION AND MARKING

- A. All drain and test valves, provided by the fire protection Contractor in accordance with this specification section shall be identified by the attachment of durable metal or plastic tags upon which the valve function or description shall be embossed/engraved.

NOTE: Labeling and posted operating procedures shall incorporate the identification system established by the Owner/Contracting Officer (as applicable).

- B. Tags shall be bound securely to the valve by means of stainless steel wire or adhesive glue for control panels. In all cases, the tags will be bound in such a position as to present minimum opportunity for loss and maximum visibility. In no case will the tags be attached to handwheels.

3.4 TESTING AND CLEANING

- A. Cleaning shall be in accordance with NFPA 13.

- B. All tests shall be witnessed by the Contracting Officer. It is a responsibility of the Contractor to provide adequate notice (ten working days) to the Contracting Officer of all testing to be performed..

C. Hydrostatic Tests

- 1 Piping shall be hydrostatically tested at not less than 200 PSI for two hours.
- 2 Prior to the commencement of field tests, one certified copy of the Contractor's Material Test Certificate for hydrostatic tests shall be submitted to the Contracting Officer.
- 3 All system piping must be thoroughly flushed and free from foreign material.

D. Acceptance Testing

- 1 The Contractor shall perform acceptance tests specified in NFPA 13 and NFPA 24. The following tests shall be conducted, but not limited to:
 - a Hydrostatic test
 - b Flush test
 - c Waterflow tests
 - d Main drain flow tests
 - e Alarm and supervision tests
 - f Operational tests
 - g Dry-Pipe Trip Test
 - h Air Pressure Maintenance Test

- E. In the event that any system or component fails to meet the guarantees, and the Contractor has made such alterations and modifications as he feels necessary to obtain the guaranteed performance, the system(s) shall be retested. The entire expense of the additional tests required to demonstrate the effects of such alterations and modifications shall be borne by the Contractor. The "entire expense" shall be interpreted as all outside charges incurred during the retesting other than for use of the normal operating forces of the Owner.

- F. All final field acceptance tests shall be witnessed by representatives from the local authority having jurisdiction, insuring interest, Owner, and Contracting Officer.

3.5 Test Documentation. Documentation specified in this specification shall be submitted to the Contracting Officer within 30 days of completion of satisfactory testing.

END OF SECTION 210500

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SECTION 220500 - GENERAL PROVISIONS

PART 1 – GENERAL

1.1 SPECIFICATION FORM AND DEFINITIONS

- A. These Specifications are abbreviated form and contain incomplete sentences. Omissions of words or phrases such as "the contractor shall", "shall be", "as noted on the Drawings", "according to the drawings", "a", "an", "the" and "all" are intentional. Omitted words and phrases shall be supplied by inference.
- B. The term "Contracting Officer" wherever used in these specifications, shall mean LATIMER, SOMMERS & ASSOCIATES, P.A., 3639 SW SUMMERFIELD DRIVE, SUITE A, TOPEKA, KANSAS 66614, PHONE 785-233-3232, FAX 785-233-0647.
- C. When a word, such as "proper", "satisfactory", "equivalent", and "as directed", is used, it requires Engineer's review.
- D. "Provide" means furnish and install.

1.2 LOCAL CONDITIONS

- A. Visit site and determine existing local conditions affecting work in contract.
- B. Failure to determine site conditions or nature of existing or new construction will not be considered a basis for granting additional compensation.

1.3 CONTRACT CHANGES

- A. Changes or deviations from Contract, including those for extra or additional work must be submitted in writing for review of Contracting Officer . No verbal orders will be recognized.

1.4 LOCATIONS AND INTERFERENCES

- A. Location of equipment, piping and other mechanical work is indicated diagrammatically on the Drawings. Determine exact locations on job, subject to structural conditions, work of other sections of the Specifications, access requirements for installation and maintenance and approval of Contracting Officer .
- B. Study and become familiar with the Drawings of other trades and in particular the general construction plans and details in order to obtain necessary information for figuring installation. Cooperate with work of other trades, and install work in such a way as to avoid interference with work of other trades. Minor deviations, not affecting design characteristics, performance or space limitation may be permitted if reviewed by Contracting Officer prior to installation.
- C. Any pipe, apparatus, appliance or other item interfering with proper placement of other work as indicated on Drawings, specified, or required, shall be removed and if so shown, relocated and reconnected without extra cost. Damage to new or existing work caused by Contractor shall be restored as specified for new work.
- D. Do not scale Drawings for dimensions. Accurately lay-out work from dimensions indicated on Drawings unless such be found in error.

1.5 PERFORMANCE

- A. Final acceptance of work shall be subject to the condition that all systems, equipment, apparatus and appliances operate satisfactorily as designed and intended. Work shall include required adjustment of systems and control equipment installed under this specification division.

1. Space conditions shall operate at $\pm 2^\circ$ F and $\pm 15\%$ relative humidity from setpoint.

1.6 CAD FILES

- A. Computer files (DWG) will be available from LS&A to successful bidders and manufacturers for a fee of \$100. A release of liability form will be required along with payment prior to release of files. PDF's shall be made available upon request.

PART 2 – PRODUCTS

2.1 MATERIALS, EQUIPMENT AND SUBSTITUTIONS

- A. The intent of these specifications is to allow ample opportunity for bidder to use its ingenuity and abilities to perform the work to its and the Owner's best advantage, and to permit maximum competition in bidding on standards of materials and equipment required.
- B. Material and equipment provided shall be first class quality, new, unused and without damage.
- C. In general, these specifications identify required materials and equipment by naming one or more manufacturer's brand, model, catalog number and/or other identification. The first named manufacturer or product is used as the basis for design; other manufacturers named must furnish products consistent with specifications of first named product as determined by Engineer. Base bid proposal shall be based only on materials and equipment by manufacturers named, except as hereinafter provided.
- D. Where materials or equipment are described but not named, provide required items of first quality, adequate in every respect for intended use. Such items shall be submitted to Contracting Officer for review prior to procurement.
- E. Prior to receipt of bids, if Bidder wishes to incorporate products other than those named in specifications in his base bid, he shall submit a written request for review of substitutions to Contracting Officer not less than ten working days prior to bid time. Contracting Officer will review requests and acceptable items will be listed in an Addendum issued to principal bidders.
- F. Materials and equipment proposed for substitutions shall be equal to or superior to that specified in construction, efficiency utility, aesthetic design, and color as determined by Contracting Officer whose decision shall be final and without further recourse. Physical size of substitute brand shall be no larger than space provided including allowances for access for installation and maintenance. Requests must be accompanied by two copies of complete descriptive and technical data including manufacturer's name, model and catalog number, photographs or cuts, physical dimensions, operating characteristics and any other information needed for comparison.
- G. In proposing a substitution prior to receipt of bids, include in such proposal cost of altering other elements of project, including adjustments in mechanical/electrical service requirements necessary to accommodate such substitution.
- H. Within ten working days after bids are received, apparent low bidder shall submit to Contracting Officer for approval three copies of a list of all major items of equipment it intends to provide. As soon as practicable, and within 10 working days after award of Contract, submit shop drawings for equipment and materials to be incorporated in work, for Contracting Officer review. Where 10 day limit is insufficient for preparation of detailed shop drawings on major equipment or assemblies, submit manufacturer's descriptive catalog data and indicate date such detailed shop drawings will be submitted along with manufacturer's certification that order was placed within 10 working day limit.

2.2 SHOP DRAWINGS, OPERATION AND MAINTENANCE INSTRUCTIONS

- A. Submit the minimum number of shop drawings of all materials and equipment as specified in the SECTION 010100. Contracting Officer will retain one set.
 - 1. In addition, submit 1 set directly to the commissioning agent for simultaneous review.
- B. Where catalog cuts are submitted for review, conspicuously mark or provide schedule of equipment, capacities, controls, fitting sizes, etc., that are to be provided. Mark each submitted item with applicable section and paragraph numbers of these specifications, or Drawing sheet number when item does not appear in specifications. Where equipment submitted does not appear in specifications or specified equivalent, mark submittals with applicable alternate numbers, change order number or letters of authorization. Each submittal shall contain at least four sets of original catalog cuts. Each catalog sheet shall bear Equipment Manufacturer's name and address. All shop drawings on materials and equipment listed by UL shall indicate UL approval on submittal.

- C. Check all shop drawings to verify that they meet specifications and/or drawings requirements before forwarding submittals to the Contracting Officer for their review. All shop drawings submitted to Contracting Officer shall bear Contractor's approval stamp which shall indicate that Contractor has reviewed submittals and that they meet specification and Drawing requirements. Submittal review shall specifically check for but not be limited to the following: equipment capacities, physical size in relation to space allowed; electrical characteristics, provisions for supply, return and drainage connections to building systems. All shop drawings not meeting Contractor's approval shall be returned to its supplier for resubmittal.
- D. No submittals will be considered for review by the Contracting Officer without Contractor's approval stamp, or that have extensive changes made on the original submittal as a result of Contractor's review. All comments or minor notations on shop drawings shall be flagged to indicate originator of comment.
- E. Contracting Officer will not be responsible for or the cost of returning shop drawing submittals that are submitted without Contractor's review and approval stamp. A letter will be sent to Contractor by either the Contracting Officer indicating receipt of an improper submittal for pick-up by Contractor or supplier for 15 working days after date of receipt. If not picked up by the 16th working day, submittals not bearing Contractor's review and approval stamp will be disposed of by Contracting Officer .
- F. Contracting Officer 's review of shop drawings will not relieve Contractor of responsibility for deviations from drawings and specifications unless such deviations have been specifically approved in writing by Owner or its representative, nor shall it relieve Contractor of responsibility for errors in shop drawings. No work shall be fabricated until Contracting Officer 's review has been obtained with "no exceptions" or "as noted" language. Any time delay caused by correcting and resubmitting shop drawings will be Contractor's responsibility.
- G. Operating and Maintenance Manuals (Refer to Division 1 for additional requirements)
1. Submit an outline copy of installation, operating, and maintenance manuals for review and comment.
 2. Submit three copies of installation, operating, maintenance instructions, and parts lists for equipment provided. After receiving comments from outline review, instructions shall be prepared by equipment manufacturer.
 3. Keep in safe place, keys and wrenches furnished with equipment under the Contract. Present to Owner and obtain receipt for same upon completion of project.
 4. Prepare a complete notebook, covering systems and equipment provided. Submit notebook to Contracting Officer for review before delivery to Owner. Contractor at its option may prepare this notebook, or retain an individual to prepare it, shall include cost of this service in bid. notebook shall contain following:
 - a. Certified equipment drawings/or catalog data with equipment provided clearly marked.
 - b. Complete installation, operating, maintenance instructions and parts lists for each item of equipment.
 - c. A complete set of shop drawings.
 - d. Special emergency operating instructions with a list of service organizations (including addresses and telephone numbers) capable of rendering emergency service to various parts of mechanical system.
 - e. A complete reproducible set of project record drawings at 1/8" = 1'-0" scale showing all mechanical systems as installed.
 - f. All required warranties and guarantees.
 5. Provide brochures bound in black vinyl three-ring binders. Reinforce binding edge of each sheet of looseleaf type brochure to prevent tearing from continued usage. Clearly print on label insert of each brochure:
 - a. Project name and address.
 - b. Section of work covered by brochure, e.g. "Heating, Ventilating and Air Conditioning", and "Plumbing", etc.
- H. Furnish ¼" = 1'-0" scale fabrication drawings for review of ductwork and piping systems to coordinate all trades prior to fabrication. Drawings shall be furnished and approved in a timely manner to avoid construction delays. These drawings must be approved prior to the ordering, fabrication, or installation of ductwork and piping. Subcontractor shall submit one set of reproducible drawings and one set of blue line prints of piping and ductwork coordination drawings. Cost of drawing preparation, printing, and distribution shall be paid for by Subcontractor and included in its base bid.

PART 3 – EXECUTION

3.1 CUTTING AND PATCHING

- A. Do cutting and patching of building materials required for installation of work herein specified. Cut no structural members without Contracting Officer 's approval and in an approved manner.
- B. Patching shall be by mechanics of particular trade involved and shall meet approval of Contracting Officer .
- C. Drilling and cutting of openings through building materials requires Contracting Officer 's review and approval. Make openings in concrete with concrete hole saw or concrete drill. Use of star drill or air hammer for this work is not acceptable.

3.2 MUTILATION

- A. Mutilation of building finishes, caused by demolition or installation of new work shall be repaired at Contractor's expense to approval of Contracting Officer .

3.3 SETTING, ADJUSTMENT AND EQUIPMENT SUPPORTS

- A. Work shall include mounting, alignment and adjustment of systems and equipment. Set equipment level on adequate foundation and provide proper anchor bolts and isolation as shown, specified or required by manufacturers in installation instructions. Level, shim and grout equipment bases as recommended by manufacturer. Mount motors, align and adjust drive shafts and belts according to manufacturer's instructions. Equipment failures resulting from improper installation or field alignment shall be repaired or replaced by Contractor at no additional cost to Owner.
- B. Provide floor or slab mounted equipment with 3-1/2" high concrete bases unless shown or specified otherwise.
- C. Provide each piece of equipment or apparatus on the roof, suspended from ceiling or mounted above floor level with suitable structural support, platform or carrier in accordance with best recognized practice. Verify that structural members of buildings are adequate to support equipment and unless otherwise indicated on Drawings or specified, arrange for their inclusion and attachment to building structure. Provide hangers with vibration isolators where shown on the Drawings. Submit details of hangers, platforms and supports together with total weights of mounted equipment to Contracting Officer for review before proceeding with fabrication or installation.

3.4 START-UP, CHANGEOVER, TRAINING AND OPERATIONAL CHECK

- A. Perform initial start-up of systems and equipment and shall provide necessary supervision and labor to make first seasonal changeover of systems. Personnel qualified to start-up and service this equipment, including manufacturer's technicians when specified, and Owner's operating personnel shall be present during these operations.
- B. Train Owner's operating personnel at the site to operate and maintain systems and equipment installed. Keep a record of training provided to Owner's personnel listing the date, subject covered, instructors name, names of Owner's personnel attending and total hours of instruction given each individual. Training shall be video taped for future use by the Owner. Submit two copies on all tapes to Owner. Refer to 01651 for additional requirements.

3.5 PRE-FINAL AND FINAL CONSTRUCTION REVIEW

- A. At Contractor's request, Contracting Officer will make pre-final construction review to determine if to the best of its knowledge project is completed in accordance with Contract Documents.
 - 1. Items found by Contracting Officer as not complete or not in accordance with requirements of contract will be outlined in report to Contracting Officer for forwarding to Subcontractors. Subcontractor shall complete and/or correct these items, before notifying Contracting Officer it is ready for final review.
- B. All necessary system adjustments, including air systems balancing, shall be completed and all specified records and reports submitted in sufficient time to be received by Contracting Officer at least ten working days prior to date of final construction review.

- C. At final construction review, Contractors shall be present or shall be represented by a person of authority. Each shall demonstrate, as directed by Contracting Officer, that work complies with purpose and intent of contract documents and shall provide labor, services, instruments or tools necessary for such demonstrations and tests.

3.6 WALL PENETRATIONS

- A. Include the installation of all boxes, access panels and sleeves for openings required to install the work. All floor and wall penetrations shall be sealed to meet fire rating requirements using materials tested in accordance with ASTM E814.

3.7 OPENINGS, ACCESS PANELS & SLEEVES

- A. Include the installation of all boxes, access panels and sleeves for openings required to install this work, except structural openings incorporated in the structural drawings. Sleeves shall be installed for all pipes passing through structural slabs and walls. Set and verify the location of sleeves as shown on structural plans that pass through beams, only if so shown. All floor and wall penetrations be sealed to meet fire rating requirements. Access panels shall include those required to access fire dampers, VAV boxes, valves, smoke dampers, pipe chases, manual and automatic dampers, etc. Locations and sizes of panels are to be determined by the contractor and are not specifically shown on the drawings.

END OF SECTION 220500

SECTION 220501 - EXTENT OF CONTRACT WORK AND CODES

PART 1 - GENERAL

1.1 GENERAL EXTENT OF WORK INCLUDED

- A. Provide mechanical systems indicated on Drawings, specified or reasonably implied. Provide every device and accessory necessary for proper operation and completion of mechanical systems. In no case will claims for "Extra Work" be allowed for work about which Contractor could have been informed before bids were taken.
- B. Become familiar with equipment provided by other Subcontractors which require mechanical connections and controls.
- C. Electrical work required to install and control mechanical equipment which is not indicated on Drawings or specified under Division 26 shall be included.
- D. The cost and provision of larger wiring, conduit, control, and protective devices resulting from installation of equipment which was not used for basis of design as outlined in specifications shall be provided at no increase in contract price.
- E. Provide supervision to subcontractor to insure that required connections, interlocking and interconnection of mechanical and electrical equipment are made to attain intended control sequences and system operation.
- F. Furnish six complete sets of electrical wiring diagrams to Contracting Officer and three complete sets to Electrical Subcontractor. Diagrams shall show factory and field wiring of components and controls. Control devices and field wiring to be provided by Electrical Subcontractor shall be clearly indicated by notation and drawing symbols on wiring diagrams.
- G. Obtain complete electrical data on mechanical shop drawings and list this data on an approved form which shall be presented monthly or on request, to Electrical Subcontractor. Data shall be complete with wiring diagrams received to date and shall contain necessary data on electrical components of mechanical equipment such as HP, voltage, amperes, watts, locked rotor current to allow Electrical Subcontractor to order electrical equipment.

1.2 CODES, RULES AND REGULATIONS

- A. Conform to latest editions and supplements of following codes, standards or recommended practices.
 - 1. International Plumbing Code-2006.
 - 2. International Mechanical Code-2006.
 - 3. International Uniform Building Code-2003.
 - 4. National Electrical Safety Code Handbook H30 - 2002 - National Bureau of Standards.
 - 5. Occupational Safety and Health Standard (OSHA) - Department of Labor.
 - 6. NFPA No. 54 Gas Appliance & Gas Piping Installation
 - 7. NFPA No. 70 National Electrical Code-2002
 - 8. NFPA No. 90A Air Conditioning and Ventilating Systems
 - 9. NFPA No. 91 Blower & Exhaust System
 - 10. International Fuel Gas Code -2000.
 - 11. International Fire Code - 2000
 - 12. ANGETL 01-1-1, March 2004

1.3 DRAWINGS

- A. Drawings are to be considered diagrammatic for all systems. All plumbing fixtures require waste, water and vent connections and they should be provided. Any plumbing vents, relief air openings, flues, exhaust openings, etc. must be placed 10'-0" from any outside air intakes. Piping and drawings do not show all required offsets and fittings. Contractor shall include in bid costs to provide systems which will avoid and coordinate will all other building trades and systems.

1.4 TEMPORARY UTILITIES

- A. Contractor shall provide temporary utilities at their cost during construction.

1.5 COMMISSIONING – C.A. REQUIREMENTS

- A. Refer to Section 018113 for contractor requirements for Commissioning and start-up. All systems and equipment are to be commissioned unless specifically excluded in Section 018113.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 UTILITIES

- A. Contract and coordinate the installation of utility services for this structure immediately after notice to proceed. Any discrepancies between the needs of the utility providers and the contract documents should be brought to the attention of the A/E.

END OF SECTION 220501

SECTION 220503 - BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 REQUIRED WORK

- A. Provide the reasonable use of temporary HVAC systems, testing and identification as specific below.

PART 2 - PRODUCTS

2.1 PIPING IDENTIFICATION

- A. Identify piping in mechanical rooms and 20'-0" maximum spacing in all other accessible areas with Seaton setmark pipe markers with letters (min. 1" high) and flow direction arrows. Colors and wording shall be of standard pipe markers as available from Seaton or equal. Submit for approval list of colors and wording prior to purchase of pipe markers. Pipe markers shall meet applicable ANSI Standard and OSHA requirements.

2.2 VALVE IDENTIFICATION

- A. Mark all valves with Seaton No. 300-BL brass identification tags with system legend, valve number and size stamped on tag. Lettering shall be black 1/2" high. Tags shall be minimum 2" in diameter and attached to valve with Seaton No. 16 brass jack chain.
- B. Prepare four copies of typewritten list of valve tags. List shall be typed in upper case and contain tag number, valve size, type, function and location. Frame one list under glass and mount near operating instruction in main equipment rooms.

PART 3 – EXECUTION

3.1 EXCAVATION AND BACKFILL

- A. Perform necessary excavation to receive Work. Provide necessary sheathing, shoring, cribbing, tarpaulins, etc. for this operation, and remove same at completion of work. Perform excavation in accordance with appropriate section of these specifications, and in compliance with OSHA Safety Standards.
- B. Excavation
 - 1. Excavate trenches of sufficient width to allow ample working space, and no deeper than necessary for installation work.
 - 2. Conduct excavations so no walls or footings are disturbed or injured. Backfill excavations made under or adjacent to footing with lean concrete.
- C. Backfill trenches and excavations to required heights with allowance made for settlement. Tamp fill material thoroughly and moistened as required for specified compaction density. Dispose of excess earth, rubble and debris as directed by Contracting Officer.

3.2 TESTING PROCEDURES FOR PIPING SYSTEMS

- A. Test all lines and systems before they are insulated, painted or concealed by construction or backfilling. Provide fuel, water, electricity, materials, labor and equipment required for tests.
- B. Where entire system cannot be tested before concealment, test system in sections. Upon completion, each system shall be tested as an entire system.
- C. Repair or replace defects, leaks and material failures revealed by tests and then retest until satisfactory. Make repairs with new materials.
- D. Verify that system components are rated for maximum test pressures to be applied. Where specified test pressures exceed component ratings remove or isolate components from system during tests.

3.3 TEST METHODS AND PRESSURES

- A. Submit test forms in advance of testing and coordinate test observations with the Owner and Commissioning Agent prior to tests.
- B. Test methods and pressures shall be as follows:
 - 1. System Test:
 - a. Test entire system with product conveyed. Systems operating above 25 PSI shall be tested at 75 PSI or 150% of operating pressure or whichever is greater.
 - b. Allow at least 1 hour after test pressure has been applied before making initial test.
 - 2. Refrigerant Test:
 - a. Leak check completed systems first with a small amount of the proper refrigerant to be used with the pressure of this gas boosted with dry nitrogen to a pressure of 150 psig. Perform leak test with an appropriate electronic tester.
- C. All systems shall hold scheduled test pressures for specified time without loss of initial test pressure.
- D. Upon completion of testing submit five copies of a typewritten report to Contracting Officer. Report shall list systems tested, test methods, test pressures, holding time and all failures with corrective action taken.

3.4 STERILIZATION OF DOMESTIC WATER SYSTEMS

- A. After final pressure testing of distribution system thoroughly flush entire system with water until free of dirt and construction debris. Fill system with solution of liquid chlorine or hypochlorite of not less than 50 PPM. Retain treated water in system until test indicates non-spore-forming bacteria have been destroyed or for 24 hours whichever is greater.
- B. All points in systems shall have at least 10 PPM of solution at end of retention period. Open and close each valve at least six times in system during sterilization process to sterilize valve parts.
- C. When time and concentration conditions have been met, drain system and flush with fresh domestic water until residual cleaning solution is less than 1.0 PPM. Open and close each valve in system six times during flushing operation.
- D. Test samples taken from several points in shall indicate absence of pollution for two full days. Repeat sterilization as required. Acceptance of system will not be given until satisfactory bacteriological results are obtained.

3.5 CLEANING OF SYSTEMS AND EQUIPMENT

- A. After pressure testing of systems and equipment and before operational test thoroughly clean interiors of piping and equipment. Clean equipment as recommended by equipment manufacturers. Keep a log of pressure drops, blowdown, and strainer removal tracking the cleaning process. Where specific instructions are not provided, clean equipment systems as follows:
 - 1. Hot and chilled water piping and components: Fill system with a solution of 1 pound caustic soda or 3 pounds of trisodium phosphate per 100 gallons of water. Heat system water to 150 degrees F and circulate for 48 hours before draining system. Flush system thoroughly with fresh water before refilling with treated water. Treat system water as specified under Section 232500.
 - 2. Boilers: Remove relief valve from boiler and close steam or water supply line from boiler. Provide pipe connection from relief valve taping to drain or to atmosphere if steam boiler. Fill boiler with a solution of caustic soda and water at a rate of 1 pound of caustic soda per 5 HP of boiler rating. Fire boiler for 5 hours and maintain constant boiler water level. Drain boiler while still warm flush interior surfaces of boiler from top to bottom with clean water from high pressure hose. Flush until water leaving boiler is clear. Repeat boiling process as required to properly clean boiler. Water boilers shall be cleaned prior to cleaning piping systems. Water boilers shall be drained and flushed after piping system has been cleaned. Boiler water shall be treated as specified under section 232500.

3. Air Handling Systems: Before starting any air system clean all debris, foreign matter and construction dirt from air system and fan. Provide equipment requiring filters, such as air handling units, fan coil units, blower, etc., with throw-away filters. After cleaning air system install temporary filters and run continuously for a minimum of eight hours at full volume before installing permanent filters. Provide temporary throw-away filters in all permanent heating and air conditioning equipment systems being utilized during construction. Prior to testing and balancing systems, remove temporary filter media and install clean unused filters of the type specified. Clean filters shall be installed in equipment for final acceptance inspection by Contracting Officer.

3.6 MAINTENANCE OF SYSTEMS

- A. Subcontractor shall be responsible for operation, maintenance and lubrication of equipment installed under this contract. During testing and demonstration period and for entire period of temporary use during construction.
- B. Keep a complete record of equipment maintenance and lubrication and submit two copies with request for final construction review.
- C. Records shall indicate types of lubricants used and date or time when next maintenance or lubrication will need to be performed by Owner. Where special lubricants are required, Subcontractor shall provide Owner with a one year supply as determine by equipment manufacturer's recommendations.

3.7 PAINTING OF MATERIALS AND EQUIPMENT (INITIAL INSTALLATION)

- A. Painting including touch-up and refinishing of factory applied finish upon initial installation shall be by Subcontractor. Subcontractor shall be responsible for obtaining proper type of painting materials and color from equipment manufacturer.
- B. Mechanical equipment and materials shall be painted as specified and scheduled under Division 9.
- C. Omit painting of piping, insulation, and materials located in chases, concealed tunnels and where concealed above ceilings. Where these locations occur in damp or humid environments prime ferrous metal to prevent rust and corrosion.
- D. Unless specified otherwise factory built equipment shall be factory painted. Paint shall be applied over surfaces only after they have been properly cleaned and coated with a corrosion resistant primer.
- E. After installation, damage to painted surfaces shall be properly prepared and primed with primers equal to factory materials. Finish coating shall be same color and type as factory finish.
- F. Where extensive refinishing is required equipment shall be completely repainted.

3.8 FIRE STOPPING

- A. All holes or voids created by the mechanical Subcontractor to extend pipe through fire rated floors and walls and shall be sealed with an intumescent material capable of expanding up to 8 to 10 times when exposed to temperatures of 250 degrees F. It shall be ICBO, BOCAI and SBCCI (NRB 243) approved ratings to 3 hours per ASTM E-814 (UL 1479). Acceptable Material: 3M Fire Barrier Caulk, putty, strip and sheet forms. Equivalent by SpecSeal.
- B. Submit for review firestopping methods and sleeve drawings indicating all required application, methods and sleeves. Refer to Architectural drawing for locations of fire rated partitions and floors.

3.9 USE OF PERMANENT HVAC SYSTEM FOR TEMPORARY HEAT

- A. Provide the use of permanent heating and cooling systems for temporary construction conditioning. Systems shall only be used once permanent power is installed and the following guidelines are confirmed in writing prior to start-up.
 1. Systems meet the requirements for permanent and temporary use for all involved manufacturers.
 2. Temporary cartridge filters and fabric throwaway pre-filters are installed on all equipment and all ductwork openings.
 3. Filters shall be monitored daily and changed at least weekly.
 4. Duct and AHU systems shall be inspected weekly to confirm no construction dust or debris is entering the system.
 5. Piping systems have been thoroughly flushed, cleaned and treated.

6. Proper combustion air exists for gas-fired boilers or water heater.
 7. Air handling systems are turned off during heavy gyp. board sanding and painting.
- B. At the completion of construction, all duct systems and air handling equipment must be clean. Systems which are not determined acceptable to the A-E shall be re-cleaned.
 - C. All systems, whether used for temporary construction conditioning or not, shall have a 1 year warranty from the date of substantial completion, irregardless of start-up date.
 - D. Contractor shall make arrangements for all necessary power or natural gas to operate equipment during construction and shall include in bid all utility costs for such use.

END OF SECTION 220503

SECTION 220510 - SEISMIC PROTECTION

PART 1 - GENERAL

1.1 GENERAL

Note: The requirements for seismic protection measures to be applied to mechanical/electrical equipment and systems specified herein are in addition to any other items called for in other sections of these specifications.

- A. Seismic protection for mechanical equipment and components shall be provided by the Mechanical Contractor.
- B. Seismic protection for electrical equipment and components shall be provided by the Electrical Contractor.
- C. Seismic protection for general construction items, including suspended ceilings, shall be provided by the General Contractor.

1.2 MECHANICAL/ELECTRICAL EQUIPMENT

- A. Mechanical/electrical equipment shall include the following items to the extent required on plans or in other sections of these specifications:

- Boilers
- Expansion Tanks
- Water Chiller Units
- Control Panels
- Pumps with Motors
- Light Fixtures
- Motor Control Centers
- Switchboards (Floor Mounted)
- Suspended Ceiling Assemblies
- Water and Gas Piping Drain, Waste and Vent Piping
- Air and Refrigerant Compressors
- Air Handling Units
- Switchgear
- Transformers
- Ducts

1.3 MECHANICAL SYSTEMS

- A. Mechanical systems shall include the following items to the extent required on plans or in other sections of these specifications:

- Hot Water Distribution Systems
- Chilled Water Distribution Systems
- Gas Distribution Systems
- Water Supply Systems
- Sanitary Sewer Systems
- Fire Sprinkler Systems

1.4 ZONE

- A. This facility is located in Seismic Zone No. 2A.

1.5 EXCLUSION

- A. Piping and ducts that do not require special seismic restraints: Seismic restraints may be omitted from the following installations:
 - 1. Gas piping less than 1-inch inside diameter.
 - 2. Piping in boiler and mechanical equipment rooms less than 1-1/4 inches inside diameter.
 - 3. All other piping less than 2-1/2 inches inside diameter.
 - 4. All electrical conduit less than 2-1/2 inches inside diameter.
 - 5. All rectangular air handling ducts less than 6 square feet in cross sectional area.
 - 6. All round air handling ducts less than 28 inches in diameter.

7. All piping suspended by individual hangers 12 inches or less in length from the top of pipe to the bottom of the support for the hanger.
8. All ducts suspended by hangers 12 inches or less in length from the top of the duct to the bottom of the support for the hanger.

1.6 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of support and anchor. Submit pipe hanger and support schedule showing Manufacturer's figure number, size, location, and features for each required pipe hanger and support.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawings for each type of support and anchor, indicating dimensions, weights, required clearances, and methods of assembly or components.
- C. Maintenance Data: Submit maintenance data and parts lists for each type of support and anchor. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 1.
- D. Shop drawings, along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed below shall be submitted in accordance with the SPECIAL CLAUSES. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction.

Sway Braces
Flexible Couplings or Joints
Resilient Type Vibration Devices
Smoke Stacks

PART 2 – PRODUCTS

2.1 MATERIALS AND EQUIPMENT SHALL CONFORM TO THE RESPECTIVE SPECIFICATIONS AND OTHER REQUIREMENTS SPECIFIED BELOW:

2.2 BOLTS AND NUTS

- A. Squarehead bolts and heavy hexagon nuts, ANSI B18.2.1 and B18.2.2, and ASTM A 307 or A 576.
- B. Bolts, underground, ASTM A 325.

2.3 SWAY BRACE

- A. Material used for members listed in Appendix of this specification, except for pipes, shall be structural steel conforming with ASTM A 36. Steel pipes shall conform to ASTM A 501.

2.4 FLEXIBLE COUPLINGS

- A. Flexible couplings shall have same pressure ratings as adjoining pipe.
- B. Flexible ball joints conforming to the following requirements may be employed on aboveground piping. Joints shall have cast or wrought steel casing and ball parts capable of 360-degree rotation plus not less than 15-degree angular movement. Joints shall be certified to be suitable for the service intended by the manufacturer, based on not less than 2 years' satisfactory operation in a similar application.
- C. Flexible couplings and joints of the mechanical joint type may be used for aboveground or underground piping.
- D. Mechanical couplings for steel or cast iron pipe shall be of the sleeve type and shall provide a tight flexible joint under all reasonable conditions, such as pipe movement caused by expansion, contraction, slight settling or shifting of the ground, minor variations in trench gradients, and traffic vibrations. Where permitted in other sections of these specifications, joints utilizing split-half couplings with grooved or shouldered pipe ends may be used.
- E. Sleeve-type couplings shall be used for joining plain-end pipe sections. The coupling shall consist of one steel middle ring, two steel followers, two gaskets, and necessary steel bolts and nuts to compress the gaskets. Underground bolts shall be high-strength type as specified above.

- F. Guy Wires: Guy wires shall conform to Fed. Spec. RR-W-410 as follows:

5/32 inch diameter	Type V, Class 1
3/16 inch to 5/16 diameter	Type V, Class 2
1/4 inch to 5/8 diameter	Type I, Class 2

PART 3 – EXECUTION

3.1 SWAY BRACES

- A. Sway braces shall be installed on piping and duct to preclude damage during seismic activity. All bracing shall conform to the arrangements shown. Provisions of this paragraph apply to all piping within a 5-foot line around outside of building unless buried in the ground. Piping grouped for support on trapeze-type hangers shall be braced at the same intervals as determined by the smallest diameter pipe of the group. No trapeze-type hanger shall be secured with less than two ½-inch bolts. Bracing rigidity attached to pipe flanges, or similar, shall not be used where it would interfere with thermal expansion of piping.

3.2 SWAY BRACES FOR PIPING

- A. Transverse Sway Bracing: Transverse sway bracing shall be provided at intervals not to exceed those given in Appendix of this section except for cast iron soil pipe, which shall be braced at not more than 10-foot intervals.
- B. Longitudinal Sway Bracing: Longitudinal sway bracing shall be provided at 40-foot intervals.
- C. Vertical Runs: Vertical runs of piping shall be braced at not more than 10-foot vertical intervals. For small tubing, bracing shall be provided at no more than 4-foot spacing.
- D. Anchor Rods, Angles, and Bars: Anchor rods, angles and bars shall be bolted to either pipe clamps or pipe flanges at one end and cast-in-place concrete or masonry insert or clip angles bolted to the steel structure on the other end. Rods shall be solid metal or pipe as specified below. Anchor rods, angles, and bars shall not exceed lengths given in Appendix of this section.
- E. Clamps on uninsulated pipes shall be applied directly to pipe. Insulated piping shall have clamps applied over insulation vapor barrier with high-density inserts and metal protection shields under each clamp.
- F. Bolts: Bolts used for attachment of anchors to pipe and structure shall be not less than ½-inch diameter.

3.3 SWAY BRACES FOR DUCTS

- A. Transverse Sway Bracing: Transverse sway bracing shall be provided at each horizontal turn of 45 degrees or more, at the end of each duct run, and otherwise at each 30-foot interval. Walls which ducts penetrate may be considered transverse braces.
- B. Longitudinal Sway Bracing: Longitudinal sway bracing shall be provided at 60-foot intervals. Transverse bracing for one duct section may also act as longitudinal bracing for a duct section connected perpendicular to it, if the bracing is installed within 4 feet of the intersection, and it is sized for the larger duct.
- C. Bracing Angles: Bracing angles for rectangular ducts shall be in accordance with Appendix of this section.

3.4 SPREADERS

- A. Spreaders shall be provided between racked or adjacent piping runs to prevent contact during seismic activity whenever pipe or insulated pipe surfaces are less than 4 inches apart or four times the maximum displacement due to seismic force. Spreaders to be applied at same interval as sway braces. Spreaders shall be applied to surface of bare or insulated hot pipe and over insulation utilizing high-density inserts and pipe protection shields where vapor-barrier-type insulation is employed.

3.5 FLEXIBLE COUPLINGS OR JOINTS

- A. Building Piping: Flexible couplings or joints in building piping shall be provided at bottom of all pipe risers larger than 3-1/2 inches in diameter, except thermal heat distribution piping.
- B. Cast iron waste and vent piping need only comply with these provisions when caulked joints are used. Flexible bell and spigot pipe joints using rubber gaskets or no-hub fittings may be used at each branch adjacent to tees and elbows for underground waste piping inside of building to comply with these requirements.

- C. Underground Piping: All underground piping and 4-inch or larger conduit, except thermal heat distribution system, shall have flexible couplings installed adjacent to building as shown. Additional flexible couplings shall be provided as follows:
1. On each side of the joints of demarkation between soils having widely differing degrees of consolidation.
 2. At all points that can be constructed to act as anchors.
 3. On every branch of a tee and each side of an elbow.

3.6 ANCHOR BOLTS

- A. All floor or pad mounted equipment required by any Section of these specifications shall be rigidly fastened to the floor or pad by use of cast-in-place anchor bolts. Anchor bolts must conform to ASTM A 307. Anchor bolts shall have an embedded straight length equal to or at least 12 times nominal diameter of the bolt. If the size and number of the anchor bolts are not shown on the drawings then anchor bolts shall be ½" in diameter or the manufacturer's installation recommendations, whichever is the most stringent.
- B. Four bolts per item shall be provided with a minimum embedment of 12 bolts diameters, a minimum bolt spacing of 16 bolts diameters and a minimum edge distance of 12 bolts diameters. Anchor bolts that exceed normal depth of equipment foundation piers or pads shall either extend into concrete floor or the foundation shall be increased in depth to accommodate bolt lengths.
- C. Expansion anchors shall not be used to resist seismic or vibratory loads unless test data are provided to verify the adequacy of the specific anchor and application. In no case shall the expansion anchor size be less than that required for bolts in the preceding table.

3.7 RESILIENT VIBRATION ISOLATION DEVICES

- A. Selection of anchor bolts for vibration isolation devices and/or snubbers to equipment base and foundations shall follow the same procedure as in paragraph ANCHOR BOLTS except that an equipment weight equal to five times the actual equipment weight shall be used.
1. Resilient and Spring-Type Vibration Devices: Vibration isolation devices shall be selected so that the maximum movement of equipment from the static deflection point shall be 0.5 inches.

3.8 EQUIPMENT SWAY BRACING

- A. Equipment sway bracing shall be provided for all items supported from overhead floor or roof structures. Braces shall consist of angles, rods, bars, or pipes arranged as shown and secured at both ends with not less than ½-inch bolts. Bracing shall be provided in two planes of directions, 90 degrees apart, for each item of equipment. Details of all equipment bracing shall be submitted for approval. In lieu of bracing with vertical supports, these items may be supported with hangers inclined at 45 degrees directed up and radially away from equipment and oriented symmetrically in 90 degree intervals on the horizontal plane, bisecting the angles of each corner of the equipment, provided that supporting members are properly sized to support operating weight of equipment when hangers are inclined at a 45 degree angle.

3.9 LIGHTING FIXTURES IN BUILDINGS

- A. In addition to the requirements of the preceding paragraphs, lighting fixtures and supports will conform to the following:
- B. Materials and Construction:
1. Fixture supports shall be malleable iron.
 2. Loop and hook or swivel hanger assemblies for pendant fixtures shall be fitted with a restraining device to hold the stem in the support position during earthquake motions. Pendant-supported fluorescent fixtures shall also be provided with a flexible hanger device at the attachment to the fixture channel to preclude breaking of the support. The motion of swivels or hinged joints shall not cause sharp bends in conductors or damage to insulation.
 3. Recessed fluorescent individual or continuous-row fixtures shall be supported by a seismic-resistant suspended ceiling support system and shall be provided with fixture support wires attached to the building structural members using two wires for individual fixtures and one wire per unit of continuous row fixtures.
 4. A supporting assembly that is intended to be mounted on an outlet box shall be designed to accommodate mounting features on 4-inch boxes, 3-inch plaster rings, and fixture studs.

5. Surface-mounted fluorescent individual or continuous-row fixtures shall be attached to a seismic-resistant ceiling support system. Fixture support devices for attaching to suspended ceilings shall be a locking-type scissor clamp or a full loop band that will securely attach to the ceiling support. Fixtures attached to underside of a structural slab shall be properly anchored to the slab at each corner of the fixture.
 6. Each wall-mounted emergency light unit shall be secured in a manner to hold the unit in place during a seismic disturbance.
- C. Tests: In lieu of the requirements for equipment supports, lighting fixtures and the complete fixture-supporting assembly may be tested as specified hereinafter. Such tests shall be conducted by an approved and independent testing laboratory, and the results of such tests shall specifically state whether or not the lighting fixture supports satisfy the requirements given herein.
1. Test Equipment: To simulate earthquake motion, fixtures and supports shall be attached to a carriage suspended on rollers from an overhead track. A gear motor and crank assembly shall be used to provide oscillatory motion of approximately one cycle per second. The exact number of cycles per second and the actual dimensions of the crank apparatus shall be adjusted to produce a minimum carriage acceleration of 0.14g. The actual fixture-mounting surface shall be on the underside of the carriage and shall provide capacity for orienting the fixture in a horizontal plane in various positions, ranging from parallel to perpendicular to the line of traverse.
 2. Test Requirements: All tests shall be conducted with the maximum fixture weight so as to produce the most severe loading conditions. Fixtures having stems shall be tested with the actual stem lengths to be used. Tests shall be of 1-minute duration with the mounting surface in the line of traverse, at 45 degrees to the line of traverse, and at 90 degrees to the line of traverse. A total of two fixtures shall be tested in each of the above positions. After each of the six tests, the complete stem assemblies from fixtures having stem assemblies shall be subjected to a tensile strength test. The sample shall withstand, without failure, a force of not less than four times the weight it is intended to support.
 3. Acceptance: No component of a fixture nor its support shall be accepted individually. For acceptance, the fixture and its supports shall exhibit no undue damage, and no component of the fixture shall fail or fall from the fixture during testing.
- D. Design Criteria: In lieu of the above test requirements, lighting fixtures shall be designed to resist a lateral force of 56 percent of the fixture weight.
- E. Lighting Fixtures and Air Diffuser Supports: Lighting fixture and air diffuser supports shall be designed and installed to meet the requirements of equipment supports in the preceding paragraphs of this specification with the following exceptions:
1. Recessed lighting fixtures not over 56 pounds in weight and suspended and pendent-hung fixtures not over 20 pounds in weight may be supported and attached directly to the ceiling system runners by a positive attachment such as screws or bolts.
 2. Air diffusers that weigh not more than 20 pounds and that receive no tributary loading from ductwork may be positively attached to and supported by the ceiling runners.

3.10 SMOKE STACKS

- A. Stack shall be mounted directly on boilers or heat producing appliances or on floor supporting such devices with side inlets to stacks. All stacks must be supported with steel guys attached to a point three-fourths of the stack height external to the building. Guy wires shall be 1/4" 6 x 19 cable, improved plow steel with fiber core, as noted, with galvanized coating.

3.11 MISCELLANEOUS EQUIPMENT

- A. The following specific items of equipment to be furnished under this contract shall be constructed and assembled so as to be capable of withstanding the horizontal equivalent static force of 0.11 times the operating weight of the equipment, at vertical center of gravity of the equipment without causing permanent deformation, dislocations, separation of components, or other damage, which would render the equipment inoperative for significant periods of time following an earthquake.

3.12 MISCELLANEOUS EQUIPMENT

Boilers
Cooling Tower
Air-Handling Units
Transformers
Switchboards and Switchgears
Motor Control Centers
Free Standing Electric Motors

3.13 APPENDIX

- A. The following are reproductions from SMACNA Seismic Restraint Manual Chapters 4, 7 and 8 and contain details for duct, pipe conduit and equipment seismic restraint and shall be used for determining the required restraint for this project. The building shall be categorized seismic hazard level "C".

END OF SECTION 220510

SECTION 220523 – VALVES

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Provide necessary valves within piping systems to provide required flow control and to allow isolation for inspection, maintenance and repair of each piece of equipment or fixture, and on each main and branch service loop.
- B. Valves installed in piping systems shall be compatible with system maximum test pressure, pipe materials, pipe joining method, and fluid or gas conveyed in system.
- C. Valves 2-1/2" and smaller shall have soldered or screwed end connections are required by piping materials unless otherwise specified or shown on drawings. Install union connection in the line within two feet of each screw end valve unless valve can be otherwise easily removed from line. Valves 3" and over shall have flange end connections.
- D. Each valve shall be installed so that it is easily accessible for operation, visual inspection, and maintenance.
- E. Non-rising stem valves shall not be installed at any point in the piping systems. With permission of Contracting Officer non-rising stem valve may be installed at particular points where space is restricted.
- F. Provide 6" and below butterfly valves with latchlock handles for On-Off applications and with Twist-Lock infinite position handle for throttling applications.
- G. Gate valves shall not be installed in pipe lines where intended for throttling service or where piping is subject to vibration as part of normal operating conditions.
- H. Equivalent valves listed on current comparison charts of specified valve manufacturers by Apollo, Crane, Nibco, Dyna Quip, Keystone, Milwaukee, Griswold, or Homestead are acceptable.

PART 2 – PRODUCTS

2.1 BALL VALVES

- A. Ball valves shall be scheduled as type "BLV" valves. Valve specifications by type number shall be as follows:

<u>TYPE NO.</u>	<u>SPECIFICATION</u>
BLV-1	2-1/2" valves and smaller, Appolo #70-100,200 bronze full port ball valve 150PSI-SWP, 600 PSI-WOG, teflon seats, chrome plated ball, blowout proof stem, silicon bronze stem, 1-1/4" extensions or NIB seal, insulated handle where on chilled water, screwedor solder ends.

2.2 BALANCING VALVES

- A. Balancing valves shall be scheduled as Type "BAV" valves. All balancing valves may be installed on the return or supply side of coils and shall be line sized. Provide proper sized valves for the specified flows. Provide strainers at all valves. Valve specification by type number shall be as follows:

<u>TYPE NO.</u>	<u>SPECIFICATION</u>
BAV-1	3/4" thru 2 1/2": Flow Design Inc. model AC automatic type of forged brass with ball valve, flow cartridge, 400 PSIG at 250°F rating and sweat or screw connections as required.
BAV-2	3" and above: Flow Design Inc. model WS automatic type with ductile iron body with waffer style, flow cartridge and 300 PSIG at 250°F rating.
BAV-3	3/4" thru 2 1/ 2": Armstrong model CBV I or CBV II circuit balance valve, meter connections and built-in check valves, 125 psig at 250 deg. F rating and sweat or screw connections as required.

2.3 CHECK VALVES

- A. Silent check valves shall be scheduled as Type "SCV" valves. Valve specifications by type number shall be as follows:

<u>TYPE NO.</u>	<u>SPECIFICATION</u>
SCV-1	2" valves and smaller Stockham Fig. No. B-310T or B-320T bronze check valve, 125 PSI-WOG, spring, brass stem, teflon disc and seat ring, screwed or solder ends as required.
SCV-2	2-1/2" and larger Muessco #101-DT iron body stainless steel trim check valve 150 PSI-ASA with flanged ends.

2.4 BUTTERFLY VALVES

- A. Butterfly valves shall be scheduled as Type "BFV" valves. Valve specifications by type number shall be as follows:

<u>TYPE</u>	<u>SPECIFICATION</u>
BFV-1	3" thru 6", Nibco #LD-200, 200 PSI ductile iron drilled lug body, lever operator aluminum/bronze disc, type 416 stainless steel stem and EPDM sleeve valve shall be bubble tight and designed for dead end service.

2.5 PLUG VALVES

- A. Plug valves shall be scheduled as type PLV valves. Valve specifications by type number shall be as follow

<u>TYPE</u>	<u>SPECIFICATION</u>
PLV-1	1" valves and smaller Homestead Fig. 601 gas cock, 150 PSI-SWP/200 PSI-WOG, bronze plug washer and nut, screwed ends.
PLV-2	1-1/4" thru 4" valves, Rockwell-Nordstrom Fig. 142, semi-steel lubricated plug valve, 175 PSI-WOG coated plug, two bolt cover, short pattern screwed ends. Provide complete with standard pattern cast handle.

2.6 VALVE SCHEDULE

<u>SYSTEM</u>	<u>SIZE</u>	<u>STOP</u>	<u>CHECK</u>	<u>BALANCE</u>
Domestic Water	1/2"-2-1/2"	BLV-1	SCV-1,2	BAV-3
Domestic Water	3" & Up	BFV-1	SCV-2	--
Condenser Water	Up to 2-1/2"	BLV-1	SCV-1	BAV-1/3*
Condenser Water	3"-6"	BFV-1	--	BAV-2*
Gas	1/2"-1"	PLV-1	--	--
Gas	1 1/2"-4"	Plv-2	--	--

*Provide manual balance valves on all branch loops and AHU's. Provide automatic balance valves on unit heaters, VAV boxes and fan coil units.

PART 3 – EXECUTION

3.1 GENERAL

- A. Subcontractor may provide valves and accessories as individual components or as pre-assembled groupings from a single manufacturer. Refer to the details on the drawings for all required accessories.

END OF SECTION 220523.

SECTION 220529 - SUPPORTS, ANCHORS, SLEEVES AND SEALS

PART 1 – GENERAL

1.1 COORDINATION

- A. Provide proper type and size pipe sleeves for installation in concrete or masonry walls or floors. Sleeves are not required for supply and waste piping through wall supporting plumbing fixtures or for cast iron soil pipe passing through concrete slab or grade except where penetrating a membrane waterproof floor. Supervise installation of sleeves to insure proper location and installation.

PART 2 – PRODUCTS

2.1 PIPE SLEEVES AND SEALS

- A. Each sleeve shall be continuous through wall floor or roof and shall be cut flush on each side except where indicated otherwise. Sleeves shall not be installed in structural member except where indicated or approved by Structural Engineer.
- B. Sleeves passing through floors subject to flooding such as toilet rooms, bathrooms, chases, equipment rooms and kitchens shall be cast iron with integral flanges and shall extend 1 inch above finished floor. Size sleeves for and seal space between pipe sleeve with Thunderline Link-Seal.
- C. Provide steel pipe sleeves in bearing walls and masonry walls. Opening in non-bearing walls, floors and ceilings may be 20 gauge galvanized pipe sleeves or openings cut with concrete core drill.
- D. Pipe insulation shall run continuous through pipe sleeves with 1/4" minimum clearance between insulation and pipe sleeve. Provide metal jackets over insulated pipes passing through fire walls, floors and smoke partitions. Jacket shall be 0.018 stainless steel extending 12 inches on either side of barrier and secured to insulation with 3/8" wide band. Seal annular space between jacket and pipe sleeves with Metraflex "MS" where non-fire rated. Provide Metraflex "120" at all fire rated applications.
- E. Provide pipes passing through roof of floor waterproof membranes with J.R. Smith or Zurn Z-195-5 flashing sleeve. Seal pipe to sleeve with oakum and caulk with lead.
- F. Where piping passes through walls serving as supply or exhaust air plenums or chases, seal annular space between pipe and sleeve air tight with Thunderline Link Seals.
- G. Submit for review a sleeve drawing showing all required sleeves for piping.

2.2 PIPE HANGERS AND SUPPORTS

- A. Provide and be responsible for locations of piping hangers, supports and inserts, etc., required for installation of piping under this contract. Design of hangers and supports shall conform to current issue of Manufacturers Standardization Society Specification (MSS) SP-58. Application of hangers and supports shall be according to the current issue of (MSS) SP-69.
- B. Pipe hangers shall be capable of supporting piping in all conditions of operation. They shall allow free expansion and contraction of piping, and prevent excessive stress resulting from transferred weight being induced into pipe or connected equipment. Support horizontal or vertical pipes at locations of least vertical movement.
- C. Where horizontal piping movements are such that hanger rod angularity from vertical is greater than 4 degrees from cold to hot position of pipe, offset hanger, pipe, and structural attachments to that rod is vertical in hot position. Hangers shall not become disengaged by movements of supported pipe.
- D. Provide sufficient hangers to adequately support piping system at specified spacing, at changes in piping direction and at concentrated loads. Hangers shall provide for vertical adjustment to maintain pitch required for proper drainage, and for longitudinal travel due to expansion and contraction of piping. Fasten hangers to building structural members wherever practicable and as approved by Structural Engineer.
- E. Hangers in direct contact with copper pipe or tubing shall be copper plated.

F. Unless indicated otherwise on drawings support horizontal steel piping as follows:

PIPE SIZE	ROD DIAMETER	MAXIMUM SPACING
Up to 1-1/4"	3/8"	8 Ft.
1-1/2" to 2"	3/8"	10 Ft.
2-1/2" to 3-1/2"	1/2"	12 Ft.
4" and 5"	5/8"	15 Ft.
6"	3/4"	17 Ft.
8" to 12"	7/8"	22 Ft.

G. Unless indicated otherwise on drawings support horizontal copper tubing as follows:

NOM. TUBING SIZE	ROD DIAMETER	MAXIMUM SPACING
Up to 1"	3/8"	6 Ft.
1-1/4" to 1-1/2"	3/8"	8 Ft.
2"	3/8"	9 Ft.
2-1/2"	1/2"	9 Ft.
3" and 4"	1/2"	10 Ft.
5"	5/8"	12 Ft.

H. Support horizontal cast iron soil pipe with one hanger for each joint located close to hub.

I. Support vertical cast iron soil pipe and PVC pipe at every floor and steel and copper tubing at every other floor.

J. Provide continuous threaded hanger rods. No chain, wire, or perforated straps shall be used. Hanger rods shall be subject to tensile loading only, where lateral or axial pipe movement occurs provide suitable linkage to permit swing. Provide pipe support channels with galvanized finish for concealed locations and painted finish for exposed locations. Submit design for multiple pipe supports indicating pipe sizes, service and support detail to Contracting Officer for review prior to fabrication.

K. Provide Grinnell pipe hangers for vertical pipe risers as follows:

PIPE MATERIAL	PIPE SIZE	HANGER FIG. NO.
Copper	1/2" thru 4"	CT-121
Steel	3/4" thru 20"	261

L. Provide Grinnell Fig. 194, 195, or 199 steel wall brackets for piping suspended or supported from walls. Brackets shall be prime coated carbon steel.

M. Mount hangers for insulated piping on outside of pipe insulation sized to allow for full thickness of pipe insulation. Provide Grinnell Fig. 167 insulation protection shields sized so that line compressive load does not exceed one-third of insulation compressive strength. Shield shall be galvanized steel and support lower 180 degrees of pipe insulation on copper tubing.

N. Structural attachments for pipe hangers shall be as follows:

- Concrete Structure: Provide Grinnell Fig. No. 285 concrete insert for loads up to 400 lbs. and Grinnell Fig. 281 wedge type concrete insert for loads up to 1200 lbs.
- Steel Beam Structure: Provide Grinnell Fig. No. 86 malleable iron C-clamp for pipe size 2" and smaller and Grinnell Fig. 229 malleable iron beam clamp for pipe size 2-1/2" and larger.

O. Provide Grinnell pipe hangers for horizontal single pipe runs as follows:

PIPE MATERIALS	PIPE SIZE	CLAMP NO.	ROLLER NO.
Copper	1/2" thru 4"	CT-65	
Steel	3/8" thru 4"	65	
Steel	5" thru 30"	260	

P. Provide Fee and Mason Fig. 600 channel trapeze pipe hangers for horizontal multiple pipe runs with pipe clamps or pipe rollers as follows:

PIPE MATERIALS	PIPE SIZE	CLAMP NO.	ROLLER NO.
Copper	3/8" thru 4"	8600 CP*	8010 CP*
Steel	3/8" thru 6"	8500	8010

*Copper Plated

- Q. Pipe supports for horizontal piping mounted on pipe racks or stanchions shall be Advanced Thermal Systems low friction graphite slide supports or equivalent by Ella or Grinnell. Where racks and supports are not detailed on drawings submit detailed support drawings to Contracting Officer for review prior to fabrication.
- R. Provide Fee and Mason Fig. 404 vibration control hangers at locations where piping vibrations would be transmitted to building structure by conventional hangers. Apply hangers within their load supporting range.
- S. Provide Elcen Fig. 50 pipe saddle with adjuster to support piping from floor. Provide complete with pedestal type floor stand.
- T. Provide necessary structural steel and attachment accessories for installations of pipe hangers and supports. Where heavy piping loads are to be attached to building structure verify structural loading with Contracting Officer prior to installations.
- U. Equivalent hangers and supports by Auto-Grip, Basic Engineer, Elcen, Fee & Mason, Fluorcarbon Company, Unistrut or Super Strut Inc., B-Line.

2.3 EQUIPMENT ANCHORS

- A. Provide floor or foundation mounted equipment such as pumps, boilers, air handling units, etc. with Decatur Engineering Company concrete anchors.
- B. Where equipment anchors cannot be installed during forming of floors or foundations anchor equipment with McCulloch Kwik-Bolt concrete anchors.
- C. Anchors shall be proper type and size recommended by manufacturer for equipment to be anchored.
- D. Equivalent by B-Line.

2.4 CONCRETE INSERTS AND ANCHORS

- A. In new construction where attachment points can be predetermined provide Fee & Mason Fig. 9000 continuous concrete insert of Fig. 186 Universal Steel concrete insert.
- B. In existing construction or new construction where attachment points cannot be located before setting concrete forms provide McCulloch Kwik-bolt or Phillips red head concrete anchors of proper type for attachments.
- C. Equivalent by B-Line.

PART 3 – EXECUTION

3.1 RESPONSIBILITY

- A. Contractor shall take full responsibility for the final selection, installation and integrity of the piping support system.
- B. Coordinate pipe hanger locations to avoid overloading of building structural members. Add additional supports where required.

END OF SECTION 220529

SECTION 220700 - PIPING AND EQUIPMENT INSULATION

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

- A. Provide necessary materials and accessories for installation of insulation for mechanical systems as specified and/or detailed on drawings. Insulation type and thickness for specific piping systems or equipment shall be as listed in insulation schedule.
- B. Provide insulation materials manufactured by Armacell, Certain/Teed Saint Gobain, Dow Chemical, Johns-Manville or Owen-Corning.
- C. Insulation, except where specified otherwise, shall have composite fire and smoke hazard ratings as rested by ASTM E-84, NFPA 255, and UL 723 procedures not exceeding:

FLAME SPREAD	25
SMOKE DEVELOPED	50
FUEL CONTRIBUTED	50

Provide insulation accessories such as adhesives, mastics, cements, tape with same component ratings as listed above. Products or their shipping cartons shall bear label indicating their flame and smoke safety shall be permanent. Use of water soluble treatments such as corn paste or wheat paste is not acceptable. This does not exclude approved lagging adhesives.

- D. Install insulation over clean dry surfaces with joints firmly butted together. Insulation at equipment, flanges, fittings, etc. shall have straight edges with box type joints with corner beads at corners. Total insulation system shall have neat smooth appearance with no wrinkles, or folds in jackets, joint strips or fitting covers.
- E. Undamaged insulation systems on cold surface piping and equipment shall perform their intended functions as vapor barriers and thermal insulation without premature deterioration of insulation or vapor barrier. Take every reasonable precaution to provide insulation systems with continuous unbroken vapor barriers.
- F. Insulation failing to meet workmanship and appearance standards shall be replaced with an acceptable installation before final acceptance of project will be given. Insulation failing to meet performance requirements of this specification for a period of one year after date of final acceptance or through one heating season and one cooling season, whichever is longer shall be replaced with an acceptable installation. All costs to correct insulation deficiencies and costs to repair damages to other work shall be at Contractor's expense at no cost to Owner.

1.2 SUBMITTALS

- A. Provide submittals for pipe insulation used on this project as specified in Section 01010.

PART 2 – PRODUCTS

2.1 INSULATION MATERIALS AND APPLICATION METHODS

- A. Pipe insulation by type shall be as follows:

Type 1-PHC: Insulation For Hot And Cold Surface Piping systems with -70 degrees F to +450 degrees F operating range shall be Owens-Corning Fiberglass 25, 4.0 lb. density pipe insulation with white fire retardant ASJ jacket. Average thermal conductivity shall not exceed .26 BTU/Hr. at 75 degrees F mean temperature. Seal longitudinal jacket laps and butt strips with C.M. No. 17-465 or B.F. No. 85-75 vapor barrier adhesive. Insulate valves and fittings as follows: Insulate exposed and concealed valves and fittings with 2" thick glass fiberglass inserts or blankets. Cover fittings with Zeston Products PVC fitting covers or approved equal. PVC fitting covers shall be secured with mechanical fasteners such as tacks or staples for temperatures above 75 degrees F. For cold service all joints shall be sealed with vapor barrier adhesive or by pressure sensitive vapor barrier vinyl tape.

Type 1-PC: Insulation for cold surface equipment insulation for external surfaces with minus 70°F to 220°F operating temperature range shall be Armacell pipe insulation. Average thermal conductivity shall not exceed 0.27 BTU/HR at 75°F mean temperature. Apply insulation directly to metal surfaces and seal insulation joints with Armstrong No. 520. Insulation shall be mitered, beveled and built-up as required to provide a smooth and neat exterior surface. Finish insulation with two coats of Armacell "WB Armaflex" finish.

2.2 PIPE INSULATION SCHEDULE

<u>SYSTEM</u>	<u>SIZE</u>	<u>TYPE</u>	<u>THICKNESS</u>
Dom. Water Above Grade	Up to 2"	1-PHC	1/2"
Dom. Water Above Grade 2 1/2" & above	1-PHC	1"	
Dom. Water Below Grade All	1-PC	1"	
Roof Drain	All	1-PHC	1"
Refrigerant Suction	All	1-PC*	1/2"
Condensate Drains	All	1-PC	1/2"
Expansion Tanks	All	1-PC	1/2"

* Provide continuous aluminum jacketing over pipe insulation outdoors.
 Note: Hot water system valves need not be insulated.

PART 3 - EXECUTION

3.1 PIPE SUPPORTS

- A. Insulate hanger and supports from direct contact with cold or hot surfaces (-120 deg. F to 450 deg.) with "Buckaroos Inc." or approved equal pipe insulation support system. The wood dowel adhered to a PVC disc shall be installed as follows:
 - 1. Up thru 2-1/2" pipe: One "Buckaroo" placed exactly at the hanger location.
 - 2. 3" thru 5-1/2" pipe: Three "Buckaroos" placed in the lower 180 degree arc of the pipe exactly at the hanger location.
 - 3. 6" pipe and above: Nine "Buckaroos" strategically placed similar to the 3" thru 5-1/2" pipe sizes and within the length of the hanger protection saddle.
- B. The length of the "Buckaroo" insulation support same as the pipe insulation thickness. Provide ASJ type discs to reestablish vapor barrier.
- C. The insulation support system shall be installed in combination with the hanger saddles.
- D. Hanger saddle shall be "Buckaroo Inc." or approved equal, with an outward flared edge.
- E. Piping hanger cannot be isolated from cold pipe surfaces. Insulate piping at hanger locations with extra thickness of pipe insulation. Insulate hanger rod to point 12" above pipe with minimum insulation thickness equal to one-half thickness of pipe insulation. Seal and finish joints with vapor barrier sealer for insulation type used.

3.2 LAVATORIES/SINKS TRIM

- A. Insulate all exposed supplies and traps/tailpieces with Truebro "Handi Lav-Guard" insulation kit 102. Equal by Brocar Products.

END OF SECTION 220700

SECTION 22 1113 – FACILITY WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes water-distribution piping and specialties for the following:
 - 1. Water services.
 - 2. Combined water service and fire-service mains.

1.2 SUBMITTALS

- A. Product Data: For the following:
 - 1. Valves and accessories.
- B. Field quality-control test reports.
- C. Operation and Maintenance Data: For the following:
 - 1. Valves.
 - 2. Backflow Preventers
 - 3. Meters
 - 4. Hydrants

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with requirements of utility company supplying water (City of St. Joseph). Including tapping of water mains and backflow prevention.
 - 2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
 - a. Comply with City of St. Joseph Standard Specifications
 - 3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. NSF Compliance:
 - 1. Comply with NSF 14 for plastic potable-water-service piping. Include marking "NSF-pw" on piping.
 - 2. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

1.4 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
1. Notify Engineer not less than two days in advance of proposed utility interruptions.
 2. Do not proceed with utility interruptions without Engineer's written permission.

1.5 COORDINATION

- A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.
 2. Products: Subject to compliance with requirements, provide one of the products specified.
 3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
 4. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Cement Lined (DICL) Pipe: ANSI A 21.51 (AWWA C151 or latest revision), with mechanical-joint, bell- and plain-spigot end unless grooved or flanged ends are indicated.
1. All ductile iron cement lined pipe shall meet the requirements of Pressure Class 350 pipe for sizes 12" and smaller, and pressure class 250 for all pipe 16" and larger, unless otherwise indicated on the plans. The exterior of the pipe shall be coated with a bituminous coating of coal-tar or asphalt base at least one mil thick. The interior of the pipe shall have a cement lining in accordance with ANSI A21.4 (AWWA C104) with a Bituminous Seal-Coat. Joints shall be slip type with single rubber gasket in accordance with Subsection 803.6.

2. Mechanical-Joint, Ductile-Iron Cement Lined Fittings: ANSI/AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern with interior and exterior coatings as described above for DICTL.
 - a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and stainless steel bolts.
- B. PVC, Schedule 40 Pipe (2 ½" pipe and smaller): ASTM D 1784, Type 1, Grade 1 for PVC Compounds; ASTM 2241 for PVC pipe; commercial standard CS-256 for PVC pipe; and NSF Standard number 14.
 1. Class 200, suitable for working pressure of 200 psi at 73 degrees F.
 2. Push-on Joints with rubber ringed couplings conforming to ASTM D-1869.
- C. PVC, AWWA Pipe (4" and larger): AWWA C900 or C-905 depending on pipe diameter.
 1. DR-18 with Cast Iron outside diameter.
 2. Push-on Couplings with rubber rings consisting of vulcanized rubber compounds, free from porosity; or bell ends manufactured integral to the pipe.

2.4 JOINING MATERIALS

- A. Brazing Filler Metals: AWS A5.8, BCuP Series.
- B. Soldering Flux: ASTM B 813, water-flushable type.
- C. Solder Filler Metal: ASTM B 32, lead-free type with 0.20 percent maximum lead content.
- D. Butt Fusion (HDPE PIPE): Per Manufacturer's recommendations.

2.5 VALVES

- A. AWWA, Cast-Iron, Gate Valves (smaller than 12"):
 1. Double Disc gate or resilient seat wedge type gate with non-rising stem conforming to AWWA C500-80 and C509-80 or the latest revision.
 2. Open left
 3. All Bronze disc assemblies and internal parts.
 4. Resilient seat wedge-type gate valves shall have a replaceable internally reinforced specially contoured molded rubber disc seat ring attached to the face of the disc with self-locking stainless steel screws or shall consist of a gate with a bonded elastomer seat which in the closed position is fully encapsulated and effects a bubble tight seal across the disc at a full differential of 200 psi. Stem and stem nut shall be bronze material.
 5. 2-inch square operating nut, "o" ring seals,
 6. Minimum Working Pressure: 175 psi
 7. Test Pressure: 300 psi
 8. End Connections: Mechanical joint with Corten material mechanical joint bolts and nuts or approved equal.
 9. Interior Coating: Complying with AWWA C550.
 10. Exterior Coating: epoxy coated, 8 mils thick.

2.6 GATE VALVE ACCESSORIES AND SPECIALTIES

- A. Tapping-Sleeve Assemblies: Comply with MSS SP-60. Include sleeve and valve compatible with drilling machine.
 - 1. All tapping of water mains shall be completed by the City of St. Joseph Water Utility Division at the contractor's expense.
- B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," bottom section with base of size to fit over valve, and approximately 5-inch- diameter barrel.
 - 1. Operating Wrenches: Steel tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

2.7 FIRE HYDRANTS

- A. Approved Fire Hydrants: All Hydrants must be as specified within the Missouri American Water Company Standard Specifications.

2.8 CORPORATION VALVES AND CURB VALVES

- A. Manufacturers:
 - 1. Grinnell Corporation; Mueller Co.; Water Products Div.
- B. Service-Saddle Assemblies: Comply with AWWA C800. Include saddle and valve compatible with tapping machine.
 - 1. All tapping of water mains shall be completed by the City of St. Joseph Water Utility Division at the contractor's expense.
- C. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," bottom section with base of size to fit over curb valve, and approximately 3-inch- diameter barrel.
 - 1. Shutoff Rods: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.

2.9 REINFORCED CONCRETE VALVE VAULTS

- A. All reinforced concrete valve vaults shall be constructed in accordance with the City of St. Joseph Standard Specifications.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

- B. Underground Water-Service Piping: Use either of the following piping materials for each size range:
 - 1. NPS 3/4 to NPS 3 : PVC, Schedule 40 pipe; PVC, Schedule 40 Push-on joint with rubber ringed couplings.
 - 2. NPS 4: PVC, AWWA C 900 pipe; DR-18; AWWA Class 150 molded fittings; and gasketed joints.
- C. Underground Fire-Service-Main (12" and smaller): Ductile-iron Cement Lined (DICL) Pressure Class 350, AWWA C151, mechanical joint fittings, AWWA C110.
 - 1. DICL Joint ends per AWWA C111.

3.2 VALVE APPLICATIONS

- A. General Application: Use mechanical-joint-end valves for NPS 3 and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FM, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 and smaller installation.
- B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Underground Valves, NPS 3 and Larger: AWWA, cast-iron, nonrising-stem, resilient-seated, gate valves with valve box.

3.3 JOINT CONSTRUCTION

- A. Make pipe joints according to the following:
 - 1. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA C110.
 - 2. Copper Tubing Soldered Joints: ASTM B 828. Use flushable flux and lead-free solder.
 - 3. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.
 - 4. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure. Refer to Division 2 Section "Utility Materials" for joining piping of dissimilar metals.

3.4 PIPING INSTALLATION

- A. All water line installation shall be in accordance with the City of St. Joseph Standard Specifications. The City Standard Specifications shall be utilized should there be any discrepancies between these specifications, the plans and the City Standard Specifications.
- B. Water-Main Connection: Arrange with utility company for tap of size and in location indicated in water main.
- C. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41. All Ductile iron pipe and fittings shall be wrapped in an 8-mil polyethylene wrap. The wrap shall be

continuous, securely taped and provide a continuous barrier between the pipe and bedding/backfill. Installation of wrap per manufacturer's recommendations.

- D. Install PVC, AWWA pipe according to AWWA M23 and ASTM F 645.
- E. Bury 8" and smaller piping with depth of cover over top at least 42 inches, with top at least 12 inches below level of maximum frost penetration.
- F. Bury 12" to 16" piping with depth of cover over top at least 48 inches, with top at least 12 inches below level of maximum frost penetration.
- G. Extend water-service piping and connect to water-supply source and building water piping systems at outside face of building wall in locations and pipe sizes indicated.
 - 1. Terminate water-service piping at building wall until building water piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building water piping systems when those systems are installed.
- H. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

3.5 ANCHORAGE INSTALLATION

- A. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
 - 1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
 - 2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
 - 3. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.6 VALVE INSTALLATION

- A. AWWA Gate Valves: Comply with AWWA C600, C603 and AWWA M44. Install each underground valve with stem pointing up and with valve box.
 - 1. Valve boxes to be installed vertical and plumb.
- B. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.
- C. Concrete supports shall be provided under valves in vaults. The support shall be constructed one inch (1") low and the void between the support and valve filled with non-shrink grout. Buried valves shall be supported on poured concrete blocks.

3.7 SEPARATION OF WATER MAINS AND SEWERS

- A. When potable water pipes and gravity sanitary sewers are laid parallel to each other, the horizontal distance between them shall be not less than 10' (ten feet). The distance shall be measured from edge to edge. The laying of water pipes and sanitary sewers shall be in separate trenches with undisturbed earth between them. In cases where it is not practical to

maintain a 10' (ten foot) separation, the Engineer will consider proposals providing equivalent protection by other methods on a case-by-case basis.

1. When a water pipe and a sanitary sewer cross and the sewer is 2' (two feet) or more (clear space) below the water pipe, no special requirements or limitations are provided herein. At all other crossings, the sanitary sewer is to be constructed of one (1) of the following materials and the water pipe shall be pressure tested to assure water tightness pursuant to the section on exfiltration tests.
 2. Ductile iron pipe conforming to ASTM A536 or ANSI/AWWA C151/A21.51 with minimum thickness Class 50, and gasketed, push-on, or mechanical joints in conformance with ANSI/AWWA C110/A21.10 or ANSI/AWWA C111/A21.11.
 3. PVC pipe conforming to ASTM D3034 with minimum wall thickness of SDR35 or ASTM F679 with gasketed push-on joints in conformance with ASTM D3212.
 4. Reinforced concrete pipe conforming to ASTM C76 with gasketed joints in conformance with ASTM C361 or ASTM C443.
- B. Joints in the sewer pipe shall be located as far as practical from the intersected water main with a 20' length of pipe centered on the waterline.
- C. Where a water main is laid across or through an area where there is an existing sanitary sewer, which is not constructed of one of the above specified materials and is 2' (two feet) or less below the water pipe, the existing sewer shall be encased in concrete with a minimum of 6" (six inches) thickness for a 10' (ten foot) distance on each side of the crossing or the crossed section of sewer replaced to meet the above specified construction requirements.
- D. The same horizontal separation requirements as listed above shall apply in the same manner to water service pipes and building sewers.
- E. There are to be no physical connections between any parts of the potable water system with building sewers, sanitary sewers or wastewater treatment facilities by means of which it would be possible for sewage, even under exceptional circumstances, to reach the wells, storage reservoirs or distribution systems.

3.8 REINFORCED CONCRETE VALVE VAULTS

- A. All reinforced concrete valve vaults shall be installed per City of St. Joseph Standard Specifications.

3.9 CONNECTIONS

- A. Piping installation requirements per the City of St. Joseph Standard Specifications. Drawings indicate general arrangement of piping and specialties.
- B. Connect water-distribution piping to existing water main. Use tapping sleeve and tapping valve.

3.10 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered and after thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- B. Hydrostatic Tests: Test at not less than 1-1/2 times working pressure for 2 hours.

1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

- C. Prepare reports of testing activities.

3.11 IDENTIFICATION

- A. Install continuous underground detectable warning tape during backfilling of trench for underground water-service piping. Locate below finished grade, directly over piping. See Division 32 Section "Earth Moving" for underground warning tapes.
- B. Location Wire: Contractor shall furnish and install #12 THNN copper location wire. Wire to lay adjacent to and below the centerline of all new mains and service lines. Wire to extend up in all valve boxes, meter boxes. Wire in valve box to be located in ½" PVC.

3.12 CLEANING

- A. Clean and disinfect water-distribution piping as follows:
1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
 3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or as described below:
 - a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
 - b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
 - c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
- B. Prepare reports of purging and disinfecting activities.

END OF SECTION 22 1113

SECTION 221116 - PIPING AND FITTINGS

PART 1 – GENERAL

1.1 SUBMITTALS

- A. Provide submittals for piping used on this project as specified in Section 01010.

PART 2 – PRODUCTS

2.1 PIPING MATERIALS AND FITTINGS

- A. Piping used throughout project shall conform to the following specifications. Piping shall be plainly marked with manufacturers name and weight. Piping materials shall be as follows:

1. Cast Iron Bell and Spigot Soil Pipe:
 - a. Pipe and fittings shall be gray cast iron bell and spigot ends with lead grooves and spigot end lead beads. Pipe and fittings shall be coated inside and out with asphaltum preservative and meet requirements of current Cast Iron Soil Pipe Institute Standard HS-67 and ASTM Standard A74-94.
 - b. Seal joints with lead and oakum in accordance with current ANSI Specification A40.8.
 - c. (Optional) Seal joints with neoprene pipe gaskets meeting current ASTM Standard A564-68.
 - d. Pipe and fittings by Tyler Pipe or Charlotte. AB & I
2. Hubless Cast Iron Soil Pipe:
 - a. Pipe and fittings may be gray cast iron with spigot bead and positioning lug. Pipe and fittings shall be coated inside and out with asphaltum preservative and shall meet requirements of current Cast Iron Pipe Institute Standard 301-95, ASTMA888.
 - b. Pipe joints shall be no-hub joint couplings consisting of neoprene rubber sleeve, stainless steel shield and clamp assembly. CISPI 310-95.
 - c. (Optional) Pipe joints shall be MB coupling consisting of cast iron housing with neoprene gasket and 18-8 stainless steel bolts and nuts.
 - d. Pipe and fittings shall be by Tyler Pipe or Charlotte.
3. Carbon Steel Pipe (1/8" thru 2"):
 - a. Provide seamless carbon steel conforming to ASTM specification A-106 scheduled.
 - b. Pipe joints shall be threaded conforming to ANSI Standard B2.1.
 - c. Pipe ends shall be beveled for welding.
 - d. Pipe by Armco, Jones and Laughlin Steel Corp., Youngstown Sheet and Tube Co., or United States Steel.
4. Carbon Steel Pipe (2-1/2" and above):
 - a. Provide furnace butt-welded carbon steel pipe conforming to ASTM Specification A-53.
 - b. Pipe ends shall be beveled for welding.
 - c. Pipe by Armco, Jones and Laughlin Steel Corp., Youngstown Sheet and Tube Co., or United States Steel.
5. Copper Tube:
 - a. Provide hard temper copper water tube conforming to requirements of current ASTM Specification B-88. Tubing shall be Type K, L, or M as listed in schedule.
 - b. Tubing joints shall be soldered or brazed. See schedule for joining method to be used.
 - c. Pipe by Anaconda, Cerro, Chase, Mueller or Revere Copper.
6. Copper Tube Type ACR:
 - a. Provide hard temper nitrogenized copper refrigerant tube conforming to requirements of current ASTM B-88. Tubes shall be type L or K as listed in schedule.
 - b. Tubing joints shall be brazed.
 - c. Pipe by Anaconda, Cerro, or Mueller.

7. Plastic Soil Pipe
 - a. Below grade/exterior pipe and fittings shall be ABS solid wall pipe extra strength conforming to SDR-23.5 & ASTM-D-275-69.
 - b. Below slab pipe and fittings shall be PVC-DWV conforming to ASTM-D-2665.

2.2 PIPING FITTINGS

- A. Piping fitting used throughout project shall be proper type for installation method used and shall be compatible with piping system material. Fittings listed in piping material schedule shall conform to the following specifications:
 1. Malleable Iron Screwed Fittings:
 - a. Provide screwed malleable iron fittings conforming to ANSI Standard B16.3, and ASTM Specification A-47 grade 32510.
 - b. Fittings by Crane, Grinnell or Stockham.
 2. Cast Iron Screwed Fittings:
 - a. Provide screwed cast iron fittings conforming to ANSI Standard B16.4, B2.1, and ASTM Specification A-126, Class A.
 - b. Fittings by Crane, Grinnell or Stockham.
 3. Wrought Copper Fittings:
 - a. Provide wrought solder joint copper tube fitting conforming to ANSI Standard B16.22
 - b. Fittings by Anaconda, Chase or Nibco.
 4. Cast Bronze Fittings:
 - a. Provide cast bronze solder joint fittings conforming to ANSI Standard B16.18.
 - b. Fittings by Anaconda, Chase or Nibco.
 5. Pipe Flange Gaskets:
 - a. Provide 1/16" thick synthetic gaskets full face or ring type as required. Gaskets shall be factory cut.
 - b. Gaskets by John Crane Co. Mfg. Co., Garlock Company, or Raybestos Manhattan.
- B. T-drill fittings are not acceptable on this project.

PART 3 – EXECUTION

3.1 PIPING INSTALLATION

- A. Piping systems materials and installation shall conform with the following standards and codes.
 1. System: Heating and Air Conditioning Piping
Code: ANSI Standard B31.1.0 "Power Piping"
 2. System: Natural Gas Piping
Code: ANSI Standard B31.12 "Fuel Gas Piping"
 3. System: Plumbing System Piping
Code: International Assoc. of Plumbing & Mechanical Official's "International Plumbing Code"
- B. Pipe sizes indicated on Drawings and as specified refer to nominal size in inches for steel pipe, cast iron pipe and copper tubing, unless otherwise indicated. Pipes are sized to nearest 1/2". In no case shall piping smaller than size specified be used.

- C. Contractor shall provide and be responsible for proper location of pipe sleeves, hangers, supports, and inserts. Install hangers, supports, inserts, etc., as recommended by manufacturer or as specified and detailed on drawings. Verify construction types and provide proper hangers, inserts and supports for construction used. Install inserts, hangers and supports in accordance with manufacturers load ratings and provide for thermal expansion of piping without exceeding allowable stress on piping or supports. Provide copper plated hangers and supports for suspension of insulated copper tubing lines.
- D. Install piping parallel with building lines and parallel with other piping to obtain a neat and orderly appearance of piping system. Secure piping with approved anchors and provide guides where necessary to insure proper direction of piping expansion. Piping shall be installed so that allowable stress for piping, valves and fittings used are not exceeded during normal operation or testing of piping system.
- E. Install piping so that systems can be completely drained. Provide piping systems with valve drain connections at all low pipe and ahead of all sectionalizing valves whether shown on plans or not. Drain lines shall be as follows:

<u>PIPE SIZE</u>	<u>DRAIN SIZE</u>
3/4" thru 2"	3/4"
2-1/2" thru 5"	1"

Drain valves on hot water system shall have lock shields and plugged or capped outlets to protect system from inadvertent drainage.

- F. Pitch all piping and where possible make connections from horizontal piping so that air can be properly vented from system. Provide air vents as specified at all system high points and at drop in piping in direction of flow. Use eccentric fittings as listed in piping schedules. Fitting shall be approved factory made type with threaded or weld ends as required. Fitting pressure and temperature ratings shall be equal to or exceed maximum operating temperature and working pressure of piping system. No mitered or field fabricated pipe fittings will be permitted.
- G. All pipe threads shall meet ANSI Standard B2.1 for taper pipe threads. Lubricated pipe threads with Astroseal teflon thread sealant rated for gas service and lubricating compound is not acceptable. Powdered or made-up compound will not be permitted. Pipe thread compound shall be applied only to male pipe threads.
- H. Welded pipe joints shall be made by qualified welding procedures and welders. Welding electrodes shall be type and material recommended by electrode manufacturer for materials to be welded. All pipe and fittings ends shall be beveled a minimum of 30 degrees prior to welding.
- I. Brazed socket type joints shall be made with suitable brazing alloys. Minimum socket depth shall be sufficient for intended service. Brazing alloy shall be end fed into socket, and shall fill completely annular clearance between socket and pipe or tube. Brazed joints depending solely upon a fillet rather than a socket type joint will not be acceptable.
- J. Soft soldered socket type joints shall be made with 95-5 tin-antimony solder as required by temperature and pressure rating of piping system. Soldered socket joints shall be limited to systems containing non-flammable and non-toxic fluids. Soldered socket-type joints shall be limited to systems containing non-flammable and non-toxic fluids. Soldered socket-type joints shall not be used on piping systems subject to shock or vibration. Soldered joints depending solely upon a fillet rather than a socket-type joint is not acceptable.
- K. Make changes in piping size and direction with approved factory made fittings. Steel pipe and fittings 2-1/2" and smaller shall be threaded type, pipe and fittings 3" and larger shall be weld end type. Provide fittings suitable for at least 125 PSI working pressure or of pressure rating required for maximum working pressure of system whichever is greater.
- L. Where pipe sizes of header or branch water supply piping do not appear on drawings, size piping to plumbing fixtures as follows:

FIXTURE TYPE	MAXIMUM QUANTITY OF FIXTURES	PIPE SIZE	
		CW	HW
Water Closet (Flush Valve)	1	1-1/2	--
Water Closet (Flush Valve)	2	2	--
Water Closet (Flush Valve)	5	2	--
Urinal	1	1	--
Urinal	2	1-1/4"	--
Urinal	6	2	--
Lavatory	1	1/2	1/2
Lavatory	3	3/4	3/4
Lavatory	6	1	1
Service Sink	1	1/2	1/2
Service Sink	4	1	1

3.2 WELDING

- A. Contractor shall be responsible for quality of welding and suitability of welding procedures. All welding shall be in accordance with American Welding Society Standard B3.0 and ANSI Standard B31.1.
- B. Welding shall be done only by welders who have successfully passed welder qualifications tests in previous 12 months for type of welding required. Each welder shall identify his work with a code marking before starting any welded pipe fabrication. Subcontractor shall submit three copies of a list of welders who will work on project listing welders code, date and types of latest qualification test passed by each welder.
- C. Welded joints shall be fusion welded in accordance with Level AR3 of American Welding Society Standard AWS D10.9 "Standard for Qualification of Welding Procedures and Welders for Pipe and Tubing". Welders qualified under National Certified Pipe Welding Bureau will be acceptable.
- D. Bevel all piping and fittings in accordance with recognized standards by flame cutting or mechanical means. Align and position parts so that branches and fittings are set true. Make changes in direction of piping systems with factory made welding fittings. Make branch connections with welding tees or forged weldolets.

3.3 SCHEDULE

<u>SYSTEM</u>	<u>SIZE</u>	<u>TYPE</u>	<u>FITTINGS</u>	<u>DURATION</u>
Dom. Water Above Grade	All	Copper-L	Copper	150 psi/1 hr.
Dom Water Below Grade	All	Copper-K	Copper	150 psi/1 hr.
Heat Pump Water, Above Grade	1/2"-2"	Copper	Copper	75psi/1 hr.
Heat Pump Water, Above Grade	2½"-8"	Steel-40	Steel/Weld*	75psi/1 Hr.
Heat Pump Water, Below Grade	All	Steel-80	Steel/Weld*	150psi/1hr.
Condensate Drain	All	Copper-M**	Copper**	
Waste/Vent Above Grade	All	CI	No-hub	10 ft 1/2 hr.
Waste/Vent Below Slab	All	CI	No-hub	10 ft 1/2 hr.

*Victaulic type grooved fittings are acceptable.
 ** Schedule 40 PVC where not in plenum return.

3.4 COORDINATION

- A. Refer to Section 260500 for fabrication drawings requirements. Drawings must be submitted for review and approval in a timely manner prior to ordering, fabricating, or installing piping and pipe accessories.

END OF SECTION 221116

SECTION 22 1313 – FACILITY SANITARY SEWERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes sanitary sewerage outside the building.

1.3 DEFINITIONS

- A. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Non-pressure-Piping Pressure Ratings: At least equal to system test pressure.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Sewer cleanouts.
 - 2. Manhole cover inserts.
- B. The Contractor shall furnish certification that all sanitary sewer materials comply with the requirements of these Specifications.
- C. Shop Drawings: Include plans, elevations, details, and attachments for the following:
 - 1. Precast concrete manholes, including frames and covers.
 - 2. Cast-in-place concrete manholes and other structures, including frames and covers.
- D. Design Mix Reports and Calculations: For each class of cast-in-place concrete.
- E. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic structures, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.

- C. Handle precast concrete manholes and other structures according to manufacturer's written rigging instructions.

1.7 PROJECT CONDITIONS

- A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.
- B. Locate existing structures and piping to be closed and abandoned.
- C. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Engineer not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Engineer's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Where the Plans call for sanitary sewer pipe, the Contractor may use either ductile iron pipe or polyvinyl chloride pipe but must not interchange types of pipe unless otherwise noted on the plans or approved by the Engineer. When the Plans call out a certain type and/or class of pipe, this pipe will not be substituted.

2.2 PIPES AND FITTINGS

- A. Ductile-Iron Sewer Pipe: Ductile iron pipe shall meet the requirements of AWWA C151/ANSI A21.51 and AWWA C150/ANSI 21.50. Minimum wall thickness shall be Class 52 unless otherwise specified on the plans for pipe greater than 6" and Class 52 on 4" pipe.
 - 1. Mechanical joints for ductile-iron pipe shall be gasketed and bolted joints meeting the requirements of the latest revision of ANSI A21.10 (AWWA C110).
 - 2. Except when mechanical joints are specified in the Plans, ductile-iron pressure pipe may be joined with a single rubber gasket push-on joint. Push-on joints used shall meet the requirements of the latest revision of ANSI A21.10 (AWWA C110), "Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings".
 - 3. Fittings: All fittings used with ductile-iron pipe shall be cast-iron or ductile-iron fittings meeting the requirements of the latest revision of ANSI S21.10 (AWWA C110), "Gray-Iron and Ductile-Iron Fittings, 3 Inch through 48 Inch, for Water and Other Liquids."
 - 4. Protective Coatings: The exterior of all underground ductile iron pipe and fittings shall have a bituminous coating according to AWWA C151/A21.51 and be 1-mil in thickness.
 - 5. All buried ductile iron pipe and fittings shall be encased in seamless, 8 mil, polyethylene (PE) tube conforming to ANSI/AWWA C105/A21.5. Encasement shall be installed in accordance with the following installation:
 - a. Method A: Ends of tubing shall be overlapped at least 12" and shall be thoroughly sealed with PE adhesive tape.
 - b. Repairs: All cuts, tear, punctures, or other damage to the PE shall be repaired using adhesive tape or with a short length of PE sheet or tube cut open, wrapped around the pipe to cover the damaged area and secured in place.

6. Protective Lining: The inside of the pipe (8" and larger) shall be lined with a chemically inert liner such as "Polylined" as manufactured by United States Pipe & Foundry Company or approved equal. Liner shall have a nominal thickness of 40 mils and a minimum thickness of 20 mils.
- B. Polyvinyl Chloride (PVC) Pressure Pipe and Fittings: ASTM D 1785, Schedule 40 pipe, with plain ends for solvent-cemented joints with ASTM D 2466, Schedule 40, socket-type fittings.
- C. Polyvinyl Chloride (PVC) Plastic Pipe:
1. Gravity Sewer Lines: Polyvinyl Chloride (PVC) solid wall pipe and fittings with integral bell elastomeric seal joints, shall conform to the requirements of ASTM Designation: D-3034 for nominal sizes of 8 inch through 15 inch and ASTM Designation F679-PS46 for nominal sizes of 18 inch through 27 inch, with a standard dimension ratio (SDR) of 35 or better for all gravity sewers. Pipe and fittings shall be manufactured from Type I, Grade I, Polyvinyl Chloride (PVC) compound and materials conform to the requirements of ASTM Designation: D 1784, Class 12454-B. The materials shall have a tensile strength and tensile modulus tested in accordance with ASTM Designation: D 638.
 2. PVC pipe fittings shall have the same pressure rating as the pipe and shall be marked on the body or hub on both sides. The markings shall include the manufacturer's name or trademark, nominal size, grade rating and symbol PVC type designation: i.e. PVC Type 1.
 3. Joints: The pipe shall be joined with a bell-and-spigot type of rubber gasketed joint. Each joint shall consist of a formed bell complied with a single rubber gasket. All fittings shall utilize rubber gasketed joints. The gaskets shall meet the requirements of ASTM Designation: F 477 with configuration conforming to the requirements of ASTM Designation: D 3212.
 4. Gasket Joint Pipe (PVC): The following requirements shall be applicable to all varieties of Polyvinyl Chloride (PVC) plastic pipe provided under this Contract.
 - a. Gasket joint pipe shall meet all of the manufacturing requirements specified herein. The pipe shall be coupled and sealed against infiltration and exfiltration by means of rubber rings seated in the integral bell. Pipe that has an integral bell as a part of the pipe with a single gasket will be approved. All integral bells shall having a seating depth recommended by the manufacturer and acceptable to the Engineer. The male ends of the pipe shall be fabricated for ease of entry into the coupling.
 - b. The manufacturer shall deliver the pipe to the job site by means which will adequately support it and not subject it to undue stress. The load shall be so supported that the bottom rows of pipe are not damaged by crushing. The pipe shall be carefully unloaded and stored on the project at a site prepared and furnished by the Contractor.
 - c. All gasketed joints shall be lubricated as recommended by the pipe manufacturer and as approved by the Engineer.
- D. Service Lines: Four (4) inch and Six (6) inch PVC pipe and fittings shall conform to the requirements of ASTM D1785 & ASTM D2665 Schedule 40.
1. Materials used in manufacturing of the pipe shall conform to the compound requirements of ASTM Designation: D 1784, Cell Class 12454 B.
 2. A prefabricated adapter shall be used between the SDR branch fitting and the Schedule 40 service line. The adapter shall be an IPS hub by sewer spigot model manufactured by GPK or approved equal. A concrete cradle under the wye will not be required for PVC Pipe unless shown on the plans or directly by the Engineer.

2.3 MANHOLES

- A. Normal-Traffic Precast Concrete Manholes: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for rubber gasketed joints.
1. Diameter: 48 inches minimum, unless otherwise indicated.
 2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
 3. Base Section: 8-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
 4. Riser Sections: 4-inch minimum thickness, and lengths to provide depth indicated.
 5. Top Section: concentric-cone type, unless eccentric-cone type or flat-slab-top type is indicated or use eccentric-cone if manhole is greater than 4' in diameter. Top of cone of size that matches grade rings.
 6. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch- diameter frame and cover.
 7. Steps: No Steps within Sanitary Sewer Manholes
- B. Manhole Frames and Covers: ASTM A 48, Class 35B or higher, except as modified or supplemented herein, ductile-iron castings designed for heavy-duty service. Include 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 "SANITARY SEWER" cast into cover. All frames shall be bolted to the concrete manhole wall. All covers shall be bolted to the manhole frame.
1. Manhole frames and covers shall be manufactured so as to be fully interchangeable. All of the covers provided shall be suitable for installation on any of the frames provided and shall not rock or tip under an applied load.
 2. All castings imported into the United States shall conform to the applicable provisions of the United States Customs regulations.
 3. Bolt-down type manhole rings shall be anchored to the manhole walls with not less than four (4) three-fourths (3/4) inch diameter steel bolts embedded a minimum of fourteen (14) inches, except where the entire ring is embedded in a concrete top slab.
 4. (4) Rings and bolt-down covers shall be proved with machined surfaces, O-ring gaskets and five-eighths (5/8) inch pent-head brass cover bolts. Cover bolt heads shall fit flush or below the top of the cover. The O-ring rubber gasket shall be neoprene or other synthetic, sixty (60) plus or minus five (5) hardness when measured by ASTM D 2240 type durometer.
- C. Resilient Connectors between reinforced concrete manhole structures and pipes shall conform to the requirements of ASTM C 923 and shall be of two types:
1. Type cast into manhole wall at the manufacturing facility. the connection is completed by inserting end of pipe through connector. Connector shall be A-Lok or approved equal.
 2. Type clamped around end of pipe and grouted into opening in manhole wall. this type is suitable for connecting to an existing structure. Connector shall be Fernco Concrete Manhole Adaptor or approved equal. Non-shrink grout must be used.
 3. The purpose of the resilient connector shall be to achieve a positive watertight connection between pipe and structure. The connectors cast into manhole walls may be used as flexible connections between pipe and manhole. the connectors clamped to pipes and grouted into manhole walls must be used as rigid connections.

2.4 CONCRETE

- A. General: Cast-in-place concrete according to ACI 318, ACI 350R, and the following:
1. Cement: ASTM C 150, Type II.

2. Fine Aggregate: ASTM C 33, sand.
 3. Coarse Aggregate: ASTM C 33, crushed gravel.
 4. Water: Potable.
- B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water-cementitious materials ratio.
1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
 2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.
- C. Structure 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 one-half of pipe diameter. Form curved channels with smooth, uniform radius and slope.
 - a. Invert Slope: 2 percent through manhole (minimum) or as indicated on plans
 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. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
 2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

2.5 CLEANOUTS

- A. PVC Cleanouts: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.
1. Place top in 2'x2' Concrete pad and slope to drain away (2.00% min.) on 3" washed gravel.
 2. Provide housing in paved areas .
 - a. Deeter foundry #1815 or approved equal.
- B. Gray-Iron Cleanouts: 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.
1. Top Loading Classification: Heavy duty.
 2. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service Class, Cast-Iron soil pipe and fittings.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving".

3.2 CONSTRUCTION REQUIREMENTS

- A. Handling Pipe and Pipe Fittings: All pipe, fittings and specials shall be delivered, unloaded, stockpiled, hauled, distributed, installed, and otherwise handled in a manner which will prevent breakage or other damage thereto and which will insure the delivery and installation thereof in a sound and acceptable condition.
1. PVC pipe and fittings shall be protected from direct sunlight. It shall be stored in a horizontal position supported along its entire length and shall not be stacked more than two feet in height.
 2. Rubber gaskets shall be stored in the original containers in a cool, dark place. Rubber gaskets shall be kept away from oil and grease, sunlight, heat and ozone producing equipment.
- B. Cutting of Ductile-Iron Pipe: Cutting of ductile-iron pipe shall be done in a neat and workmanlike manner without damage to the pipe. Cutting shall be done by means of an approved type of mechanical cutter. Wheel cutters shall be used when practicable.
- C. Cutting of PVC Pipe: Cutting of pipe shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise authorized by the Engineer, cutting shall be done by means of an approved type of power saw with a fine tooth blade. Pipe shall be cut square, the burrs removed inside and outside, and the outside beveled with knife and coarse file.
- D. Location and Grade of Sewers: Sewers and structures appurtenant thereto shall be located as shown by the Plans and as staked or otherwise fixed by the Engineer. The grade and alignment of each gravity sewer shall be determined by use of a laser beam device. The line and grade of the sewer line shall be checked periodically to insure proper alignment.
1. Sewer Pipe Installation: Pipe laying shall commence at the lower end of the section and proceed upgrade. Pipe shall be laid so that the spigot or tongue end points in the direction of flow and the bell end facing upstream and bell holes excavated as required.
 2. All sewer pipe shall be installed to exact line and grade and special care shall be taken to avoid disturbing line and grade of pipe already jointed and laid. All pipe shall be graded and bedded as provided in the general excavation and trenching specifications. When pipe is installed and jointed in trench, it shall form a true and smooth line of sewer, and pipes shall not be trimmed or cut except for closures. Any pipe not making a good fit shall be removed. Pipe shall be kept in a clean condition before being installed in the trench and when installed shall have all interior surfaces of the pipe sockets and exterior surfaces of pipe joints clean and dry before any jointing is performed. When necessary in the opinion of the Engineer, a suitable swab or drag shall be pulled through each joint of pipe as it is laid and jointed.
 3. All sewers constructed under this Contract must be kept thoroughly clean. When the trench is left at night or the pipe laying stopped, the upper end of the pipe must be closed by using a watertight sewer cap or plug in the socket end of the last pipe. The downstream end of the pipe shall be plugged in a positive manner until satisfactory to the Engineer until construction, cleaning, and testing are complete.

3.3 INSTALLATION OF PIPE:

- A. Installation of Ductile-Iron Pipe: While suspended in the sling and before lowering into the trench or onto the supports, the pipe shall be inspected for defects and tapped with a light hammer to detect cracks. Defective, damaged, or unsound pipe will be rejected. The pipe shall be carefully bedded with bell holes excavated to insure that each pipe shall rest firmly upon its bed for its full length, and shall be laid true to the lines and grades shown on the Plans. Except where necessary in making connections with other lines, or as authorized by the Engineer, pipe shall be laid with the bells facing the direction of laying-upstream.

1. Install ductile-iron pressure piping according to AWWA C600 or AWWA M41.
 2. Install ductile-iron special fittings according to AWWA C600.
- B. Installation of PVC Force Main Pipe:
1. Install piping with restrained joints at tee fittings and at horizontal and vertical changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
 2. Install piping with 36-inch minimum cover.
 3. Install PVC pressure piping according AWWA M23 or ASTM D 2774 and ASTM F 1668.
- C. Installation of PVC Gravity Pipe: Polyvinyl chloride (PVC) pipe for gravity sewer lines shall be installed in accordance with the recommended practice of ASTM Designation: D2321. The installation of solvent weld joint pipe and fittings shall be made in accordance with ASTM F402.
1. PVC pipe and fittings shall be inspected for defects or damages prior to lowering into the trench. Any defective, damaged, or unsound pipe shall be repaired or replaced and all foreign matter and soil should be removed from the interior of the pipe and fittings before lowering into the trench.
 2. The pipe shall be carefully bedded with bell holes excavated to insure that each pipe shall rest firmly upon its bed for its full length, and shall be laid true to the lines and grades shown on the Plans. Except where necessary in making connections with other lines, or as authorized by the Engineer pipe shall be laid with the bells facing the direction of laying-upstream.
- D. Concrete Embedment and Encasement of Sewer Pipe: Concrete embedment or encasement of sewer pipe shall be installed where and as shown by the Plans or as provided by any other Contract Document; also where, in the opinion of the Engineer, such pipe reinforcement is necessary because of any unforeseen condition encountered in the work.
1. Concrete used in pipe embedment or encasement shall be furnished, placed and compacted in conformity with the section on concrete. Reinforcement steel shall be provided where and as required.
 2. Concrete embedment or encasement of sewer pipe shall be preceded by the following preliminary steps:
 - a. Unless a slab is cast separately, each length of pipe shall be installed on a brick or concrete block or other support approved by the Engineer and located close to the pipe bell and spaces not to exceed 5'. The pipe shall be brought to exact line and grade by means of wedges placed on each side of the pipe.
 - b. Each length of pipe shall be rigidly held in lateral and vertical alignment by means approved by the Engineer and at least 3 locations along each length of pipe. This includes anchoring to prevent the pipe from vertical movement due to flotation.
 - c. Pipe joints shall be filled or otherwise sealed with the same materials and in the same manner as other joints in the same line of sewer.
 - d. All loose material shall be removed from the trench prior to placing any concrete therein. The concrete as installed shall have a continuous and uniform contact with undisturbed trench excavation material on both sides and the bottom of the trench except (1) where side forms are indicated or permitted by the Plans or (2) where sheeting is left in place in the trench, in which case the concrete is to be poured directly against the sheeting.
- E. Installation of Pipe Joints:

1. Ductile-Iron Pipe: Pipelines or runs intended to be straight shall be laid straight. Deflections from a straight line or grade shall not exceed the quantities stipulated in Table 5 or Table 6 of AWWA C600 for ductile-iron pipe. Either shorter pipe sections or fittings shall be installed where the alignment or grade requires them.
 - a. Mechanical Joints: Mechanical joints shall be carefully assembled in accordance with the manufacturer's recommendations. If effective sealing is not obtained, the joint shall be disassembled, thoroughly cleaned, and reassembled. Over-tightening bolts to compensate for poor installation practice will not be permitted.
 - b. Push-on Joints: All instructions and recommendations of the pipe manufacturer relative to gasket installation and other jointing operations, shall be followed by the Contractor. All joint surfaces shall be lubricated with a lubricant recommended by the manufacturer and approved by the Engineer immediately before the joint is completed. Lubricant shall be suitable for use in potable water, shall be stored in close containers, and shall be kept clean. Each spigot end shall be suitably beveled to facilitate assembly.
 2. Polyvinyl Chloride (PVC) Pipe: All instructions and recommendations of the pipe manufacturer, relative to gasket installation and other jointing operations, shall be followed by the Contractor. Lubricants shall be applied in accordance and of the type recommended by the pipe manufacturer. Each pipe end and coupling shall have tapered edges to facilitate assembly.
 - a. Join PVC pressure piping according to ASTM F 402 for solvent weld joint pipe and fittings.
 3. Join dissimilar pipe materials with pressure-type couplings.
- F. Sewer Lines to be Kept Clean: All sewer lines must be kept thoroughly clean. Where a connection has been made to an existing manhole, the downstream end of the newly constructed sewer line shall be sealed so that no water or dirt can enter the existing pipe or system.. During construction, the water level in any part of the newly constructed sewer system shall not be permitted to exceed 3.5 feet in depth. Upon completion of the new construction work, all sewer lines shall be thoroughly cleaned, dewatered, and accepted by the Owner before a permanent connection is made by removing the seal.
- G. Tees and Wye Branches: Tees and wye branches shall be located at the points shown on the Plans or designated by the Engineer. The branch connection shall be set at no greater than 45° (forty-five degrees) to the horizontal and so that the lower lip of the branch is not more than two (2) inches below the outside top of the pipe. All wye branches shall be cocked to a 45° (forty-five degree) angle to the plane of the sewer line. A riser pipe for sewer service connections shall be installed to the branch where noted on the Plans. After installation, branches or riser pipes shall not be covered with backfill until determination and record has been made by the Engineer of the location of each with reference to the nearest manhole downstream therefrom, and the direction in which the branch faces.
1. When sewer is to be backfilled before the service line connection is made to building, each branch or riser pipe shall be marked with a wooden 2" x 4" extending from the branch or the top of the riser pipe vertically to within 1' (one foot) of the ground surface or as noted on the Plans. All such markers shall be securely anchored and maintained in a proper vertical position until backfilling has been completed. Branch locations shall also be marked for visual location after backfilling, with an orange 6' (six foot) steel T-post. The post shall be set along the property line, right-of-way, easement line or as noted on the Plans. Branches or riser pipes shall be closed by means of suitable stoppers, or fitted with factory-molded joints. Stoppers shall be further sealed after installation with

- mastic joint filler. All work and materials used to mark the location of the service connections or wye shall be subsidiary to other bid items.
2. Service Connections: Service connections made to the sewer prior to backfill shall not be installed in the pipe trench as vertical risers. The following sections describe two (2) methods of installing riser pipes. Each service line shall be marked with a wooden 2" x 4" extending from the line vertically to within 1' (one foot) of the ground surface or as noted on the Plans. The end of the service line shall also be marked for visual location after backfilling with an orange 6' (six foot) steel T-post placed at the property line, right-of-way or easement line or as noted on the Plans.
 - a. Method A: Where conditions permit, the branch connection shall be placed at no greater than 45° (forty-five degrees) to the horizontal and the riser pipe shall be laid on the slope not to exceed 1' (one foot) vertical to 1' (one foot) horizontal cut back into the trench bank in such a manner that the service connection pipe will have a solid bearing of undisturbed earth for bedding material to be placed. The riser pipe shall be laid to the property line or easement line on this method.
 - b. Method B: In locations where the sewer trench is too deep for the riser pipe to be extended within 6' (six feet) of the surface using Method A and the trench walls are vertical, firm, undisturbed materials, the branch connection shall be set 45° (forty-five degrees) to the horizontal and a 45° (forty-five degrees) bend shall be placed on the branch. The branch and bend shall be encased in concrete. A short piece of pipe may be required between the branch in the bend so that the riser pipe can be placed in the 45° (forty-five degrees) bend and extended up the side of the trench wall with the riser length called out on the plans. The wall of the ditch shall be recessed to contain approximately half of the riser pipe. The pipe shall be securely pinned in place by driving a minimum of two (2) stakes into the bank to prevent moving while backfilling.
- H. Separation of Water Mains and Sewers: When potable water pipes and gravity sanitary sewers are laid parallel to each other, the horizontal distance between them shall be not less than 10' (ten feet). The distance shall be measured from edge to edge. The laying of water pipes and sanitary sewers shall be in separate trenches with undisturbed earth between them. In cases where it is not practical to maintain a 10' (ten foot) separation, the Engineer will consider proposals providing equivalent protection by other methods on a case-by-case basis.
1. When a water pipe and a sanitary sewer cross and the sewer is 2' (two feet) or more (clear space) below the water pipe, no special requirements or limitations are provided herein. At all other crossings, the sanitary sewer is to be constructed of one (1) of the following materials and the water pipe shall be pressure tested to assure water tightness pursuant to the section on exfiltration tests.
 2. Ductile iron pipe conforming to ASTM A536 or ANSI/AWWA C151/A21.51 with minimum thickness Class 50, and gasketed, push-on, or mechanical joints in conformance with ANSI/AWWA C110/A21.10 or ANSI/AWWA C111/A21.11.
 3. PVC pipe conforming to ASTM D3034 with minimum wall thickness of SDR35 or ASTM F679 with gasketed push-on joints in conformance with ASTM D3212.
 4. Reinforced concrete pipe conforming to ASTM C76 with gasketed joints in conformance with ASTM C361 or ASTM C443.
 5. Joints in the sewer pipe shall be located as far as practical from the intersected water main with a 20' length of pipe centered on the waterline.
 6. Where a water main is laid across or through an area where there is an existing sanitary sewer, which is not constructed of one of the above specified materials and is 2' (two feet) or less below the water pipe, the existing sewer shall be encased in concrete with a minimum of 6" (six inches) thickness for a 10' (ten foot) distance on each side of the crossing or the crossed section of sewer replaced to meet the above specified construction requirements.

7. The same horizontal separation requirements as listed above shall apply in the same manner to water service pipes and building sewers.
 8. There are to be no physical connections between any parts of the potable water system with building sewers, sanitary sewers or wastewater treatment facilities by means of which it would be possible for sewage, even under exceptional circumstances, to reach the wells, storage reservoirs or distribution systems.
- I. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical.
 - J. 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. Maintain swab or drag in line, and pull past each joint as it is completed.
 - K. Use manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.
 - L. Use 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.
 - M. Install gravity-flow piping and connect to building's sanitary drains, of sizes and in locations indicated. Terminate piping as indicated.
 1. Install piping pitched down in direction of flow, at minimum slope of 2 percent, unless otherwise indicated.
 2. Install piping with 36-inch minimum cover.
 - N. Extend sanitary sewerage piping and connect to building's sanitary drains, of sizes and in locations indicated. Terminate piping as indicated.
 - O. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or a combination of both.

3.4 MANHOLE INSTALLATION

- A. General: Install manholes, complete with appurtenances and accessories indicated.
- B. Form continuous concrete channels and benches between inlets and outlet.
- C. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches (76 mm) above finished surface elsewhere, unless otherwise indicated.
- D. Install precast concrete manhole sections with gaskets according to ASTM C 891.
- E. Construct cast-in-place manholes as indicated.

3.5 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318 and ACI 350R.

3.6 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extension from sewer pipe to cleanout at grade. Install piping so cleanouts open in direction of flow in sewer pipe.
- B. Set cleanout frames and covers in earth in cast-in-place concrete block, 24 by 24 by 7.25 inches deep. Set with tops 1 inch (25 mm) above surrounding grade.
- C. Set cleanout frames and covers in concrete pavement with tops flush with pavement surface.

3.7 TAP CONNECTIONS

- A. Make connections to existing piping and underground structures so finished Work complies as nearly as practical with requirements specified for new Work.
- B. Use commercially manufactured saddle fittings for piping branch connections. Make branch connections from side into existing piping, Remove section of existing pipe; install saddle fitting into existing piping; and encase entire saddle with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
 - 1. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
- C. Protect existing piping and structures 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 SEWERAGE 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- (200-mm-) 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 Structures: Excavate around structure as required and use one procedure below:
 - 1. Remove structure and close open ends of remaining piping.
 - 2. Backfill to grade according to Division 2 Section "Earthwork."

3.9 FIELD QUALITY CONTROL

- A. ACCEPTANCE TESTS: All sewer lines shall undergo and pass tests to determine the soundness and workmanship regarding alignment grade, infiltration, exfiltration and/or pressure. Sewer lines which do not conform to the requirements shall be repaired and/or replaced along with all appurtenant work necessary to complete the entire work at no additional cost to the Owner and shall be retested until the sewer line is of a condition meeting the requirements. Results of each test shall be recorded by the Contractor and not less than three (3) copies of the test transcripts shall be submitted to the Engineer. The transcripts shall include sufficient information to readily identify the type of test, location tested, dated, person(s) performing the test, and the test results.

1. Visual Internal Inspection: The visual inspection of each reach of completed sewer line shall be made between manholes of gravity systems, by use of mirrors deflecting sunlight into the sewer line, or lighting systems, or when possible, a physical inspection by crawling through the sewer line. Visual inspection shall be made only after all backfill has been properly placed. The inspection is to ensure that the sewer line is clean and free of obstructions, dirt or other matter not intended to be within the system and that it has been installed to uniform grade and proper alignment. Poor alignment, non-uniform grade, infiltration, displaced joints, obstructions and/or other defects shall be corrected and/or repaired at no additional cost to the Owner, and the line then reinspected.
2. Infiltration Testing: Infiltration tests shall be performed whenever gravity sewer lines are below the groundwater table. Infiltration of ground water into newly constructed gravity sewer lines shall not exceed the rate of 200 gallons per inch of nominal pipe diameter per mile of sewer per 24-hour day. Where evidence of infiltration is discovered by the Engineer, the Contractor shall install weirs or other suitable flow rate measuring devices to determine the infiltration flow rate. The Contractor shall install flow rate measuring devices adequate to determine to the satisfaction of the Engineer that the specified infiltration limit is not exceeded for the reach of gravity sewer where evidence of infiltration is discovered. A reach is between any two (2) consecutive manholes. Where the specified infiltration limit is exceeded, the Contractor shall repair or replace the defective reach of sewer line at no additional cost to the Owner. Following repair of defective reaches of sewer line, the Contractor shall remeasure infiltration flow rates and make additional repairs until an acceptable infiltration flow rate is achieved.
3. Exfiltration Tests: An exfiltration test shall be conducted on all sewer lines above the groundwater table by the Contractor using either of the methods as set forth below except when the SUPPLEMENTARY CONDITIONS establishes a specific method to be used.
 - a. Hydrostatic Test for Gravity Systems: The exfiltration test shall be conducted on each reach of sewer line between manholes with the manholes to be tested separately.
 - 1) Exfiltration tests shall be conducted by blocking off all manhole openings, except those connecting with the reach being tested, filling the line, and measuring the water required to maintain a constant level in the manholes. Test sections shall be filled not less than twelve (12) hours prior to testing with sufficient water so that the liquid depth is a minimum of 4' (four feet) above the invert of the sewer at the upstream manhole. The test section shall be refilled prior to performing the test. The depth shall be accurately marked and the time noted. After 24 (twenty-four) hours, the depth shall again be measured and the total exfiltration calculated. The Engineer shall then determine whether the exfiltration is within the limit specified.
 - 2) The total exfiltration shall not exceed 200 (two hundred) gallons per inch of nominal diameter per mile of pipe per 24-hour day for each reach tested. For purposes of determining maximum allowable leakage, manholes shall be considered pipe of equivalent diameter. The sewer line shall be dewatered after the test is completed.
 - 3) The Contractor shall provide, at his own expense, all necessary piping between the reach to be tested and the source of water supply, together with equipment and materials required for the tests. The methods used for conducting exfiltration tests shall be acceptable to the Engineer.
 - b. Low Pressure Air Testing for Ductile Iron Gravity Systems: Air testing may be used in lieu of exfiltration testing. Air testing shall comply with ASTM Designation: C828. Procedures for air testing shall be submitted to the Engineer for review before testing is started.

- 1) Sewer lines shall be flushed and cleaned prior to testing, thus serving to wet the pipe surface as well as clear out any debris. All openings and outlets shall be plugged in a manner as to resist the test pressure. Special attention should be given to stoppers placed in laterals.
- 2) Minimum test times for a 1.0-psi pressure drop from 3.5 to 2.5 psi, for various pipe sizes has been established using the formulas contained in ASTM Standard C828 and set forth in the following table.

Nominal Pipe Size, in.	Time min./100 ft.
4	0.3
6	0.7
8	1.2
10	1.5
12	1.8
15	2.1
18	2.4
21	3.0
24	3.6

- 3) If the section of line to be tested includes more than one pipe size, calculate the test time for each size and add the test times to arrive at the total test time for the section.
 - 4) Air shall be added to the pipeline until the internal air pressure of the sewer line is raised to approximately 4.0 psi gauge. After an internal pressure of approximately 4.0 psig is obtained, allow time for the air pressure to stabilize. The pressure will normally show some drop until the temperature of the air in the test section stabilizes.
 - 5) When the pressure has stabilized and is at or above the starting test pressure of 3.5 psi gauge, commence the test. Before starting the test, the pressure may be allowed to drop to 3.5 psi. Record the drop in pressure for the test period. If the pressure has dropped more than 1.0 psi gauge during the test period, the line is presumed to have failed. The test may be discontinued when the prescribed test time has been completed even though the 1.0 psig drop has not occurred. If the pipe to be tested is submerged in ground water, determine the backpressure due to ground water submergence and increase all gauge pressures in the test by this amount.
- c. Low Pressure Air Testing of PVC Gravity Systems: Low pressure air testing used for testing of PVC lines shall be in accordance with ASTM Designation F-1417/Uni-Bell Designation UNI-B-6-90.
- 1) Low pressure air shall be slowly introduced into the sealed line until the internal air pressure reaches 4.0 psig greater than the average back pressure of any groundwater influence but not greater than 9.0 psig. After a constant 4.0 psig is reached, the air shall be throttled to maintain that internal pressure for at least two (2) minutes allowing the air temperatures to stabilize. The pressure shall then be decreased to no less than 3.5 psig and timing of the test shall commence.
 - 2) Required test times shall be as indicated in the following tables. Pipe sizes 4 through 12 inch shall be limited to 1.0 psig drop as indicated in Table I and 15 inch and larger shall be limited to 0.5 psig drop in pressure as indicated in Table II.

4. Deflection Test: All polyvinyl chloride (PVC) gravity sewer lines shall be tested by pulling a mandrel through the entire length of sewer pipe. The test shall be conducted not less than one (1) month after backfill has been properly installed. The maximum allowable deflection shall not exceed 5% (five percent) of the pipe's internal diameter.
 - a. Any section of pipe found not conforming to these requirements shall be replaced by the Contractor at no additional cost to the Owner, and shall then be retested.
 - b. The Owner may, prior to the end of the warranty period, conduct another deflection test with City personnel. Any pipeline found not conforming to these requirements shall be replaced by the Contractor at no additional cost to the Owner, and the Contractor shall provide an additional warranty for not less than one (1) year for that portion of pipeline so replaced.
 5. Force Main Testing:
 - a. After the force main has been installed, anchored or blocked as specified, the pipe shall be filled with water and subjected to pressure and leakage tests.
 - b. All piping shall be tested by water pressure at not less than twice the maximum operating pressure or 100 psi, whichever is greater, for a sufficient period to examine the pipeline for leakage, cracks, defects, or other faults. Any leaks shall be repaired and tests repeated until all defects have been repaired.
 - c. After approval of repairs the pressure shall be set at twice the maximum operating pressure or 100 psi, whichever is greater, and maintained for a period of 3 hours with the total loss of water being measured. The amount of water allowed to be lost during this time shall comply with AWWA C 600 for ductile iron pipe and AWWA Manual M23 for PVC pipe.
 - d. The test pressure shall be applied by a hand operated force pump, or other suitable device, with the pump taking suction from a reservoir of small enough volume so that the amount of water loss can be measured volumetrically.
 - e. The contractor shall furnish all water necessary for filling the lines and making the tests.
 - f. Any leaks which appear within one year after the date of substantial completion shall be repaired at the expense of the Contractor.
- B. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed.
1. Place plug in end of incomplete piping at end of day and when work stops.
 2. Flush piping between manholes and other structures to remove collected debris, if required by authorities having jurisdiction.
 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.
- C. 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 authorities having jurisdiction.
 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
 4. Submit separate reports for each test.
 5. Manholes: Perform hydraulic test according to ASTM C 969 (ASTM C 969M).
 6. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

END OF SECTION 22 1313

SECTION 224000 - PLUMBING FIXTURES

PART 1 – GENERAL

1.1 FIXTURES

- A. Provide plumbing fixtures as shown on drawings and as specified complete with piping and connections.

PART 2 - PRODUCTS

2.1 PLUMBING FIXTURES AND TRIM

- A. China fixtures shall be of best grade vitreous ware without pit holes or blemishes and outlines shall be generally true. Contracting Officer reserves the right to reject any piece which in its opinion is faulty. Fixtures fitting against walls shall have ground backs. Exposed piping and fittings shall be chrome plated. All fixtures noted as handicapped or accessible shall meet ADA requirements where installed.
- B. Equivalent fixtures and accessories by following manufacturers will be acceptable.
1. Fixtures: American Standard, Kohler, Eljer, or Crane, Toto, Zurn
 2. Fittings and Supports: Josam, Smith, Wade or Zurn.
 3. Seats: Church, Olsonite or Beneke.
 4. Drinking Fountains: Oasis, Halsey Taylor, Haws.
 5. Flush Valves: Sloan, Zurn, Regal, Toto
 6. Lavatory & Sink Trim: Delta, Chicago Faucet, American Standard, Kohler, Crane, Eljer, Symmons, Toto
 7. Traps, Supplies and Stops: Dearborn, Brass Craft, CentralD, Sanitary Dash or as specified under plumbing fixtures. Provide on all fixtures.
 - a. Supplies and Stops: Dearborn Fig. No. 2700 CW 1/2" compression stop and 3/8" O.D. risers in length required. Provide deep chrome plated brass escutcheons. Provide insulation on handicapped accessible hot water.
 - b. Traps: Dearborn #FS510 (1-1/2") and/or EFS507 (1- 1/4") cast brass body with cleanout and 17 gauge tube outlet "P" trap. Provide deep chrome plated brass escutcheon with set screw. Provide pre-fabricated insulation on handicapped accessible fixtures and water coolers.
 8. Emergency: Bradley, Haws, Encon.
- C. Refer to schedule on drawings.

PART 3 – EXECUTION

3.1 FIXTURES

- A. Set fixtures true and level with all necessary supports for fixtures installed before plastering or grouting is done.
- B. Provide silicone sealer around perimeter of lavatories and urinals at connection to wall. Handicap stalls shall have flush valves set to side with most clearance. Provide vacuum breakers on fixtures having hoses or where hoses can be attached.

END OF SECTION 224000

SECTION 225000 - PLUMBING EQUIPMENT

PART 1 – GENERAL

1.1 SUBMITTALS

- A. Furnish submittals for all plumbing equipment specified and used on this project.

PART 2 – PRODUCTS

2.1 FLOOR DRAINS

- A. Drains shall be type and style listed below. Unless indicated otherwise provide each drain that does not have an integral "P" trap with a deep seal cast iron "P" trap in connecting piping.
- B. Floor Drain Type 1: Wade #W-1100G floor drain, dura-coated cast iron body with bottom outlet, combination invertible membrane clamp and adjustable nickel bronze strainer. Strainer shall have a 6"x6" square top.
- C. Floor Sink Type 1: Wade #W-9142-27 12" square top floor sink, cast iron sump body with Acid Resistant Epoxy (ARE) body interior and bottom outlet, seepage pan and combination membrane flashing clamp and frame for medium duty cast iron deep flange grate with sediment bucket. Provide loose set 1/2 grate to accept indirect waste from mechanical equipment downstream.

2.2 CLEANOUTS

- A. Provide cleanout the full size of soil pipe served up to 4" I.D. Cleanouts for soil lines larger than 4" shall be 4". Provide cleanouts in base of soil pipe stacks, ends of sewer main, at changes in direction of over 45 degrees and in horizontal pipe runs exceeding 100 feet at 50 foot intervals.
- B. Install cleanouts so they are accessible by extending them through walls, floors, to outside of building or to above grade as required.
- C. Where exterior cleanouts do not occur in sidewalks, paved roadways, etc., provide a concrete pad 18" x 18" x 6" thick with top 1-1/8" above finished grade.
 - 1. Floor (Concrete Floor Finish): Zurn #ZN 1405-3 "Supremo Level-Trol Tuf-Top" dura-coated iron cleanout with square, heavy duty, scoriated Zurn nickel bronze with adjustable above to finished floor.
 - 2. Floor (Carpet Floor Finish): Zurn #ZN-1405.14" "Supremo-Level-Trol-Tuf Top" dura-coated cast iron cleanout with round, heavy duty Zurn nickel bronze top with carpet retainer and adjustable to finished floor after concrete has set.
 - 3. Wall: Zurn ZN-1440.4 "Supremo" cleanout with dura-coated cast iron ferrule and cadmium plated cast iron counter-sunk plug complete with square smooth Zurn nickel bronze wall access cover and flush over-wall frame.
 - 4. Yard: Zurn Z-1460-15 round dura-coated cast iron cleanout housing with integral seepage pan. Housing shall be complete with secured scoriated cover with lifting device.
- D. Verify floor materials used from Architectural plans and provide proper cleanout tops, where they occur in carpet, vinyl tile or ceramic tile.
- E. Equivalent cleanout by J.R. Smith, Wade, Ancon or Josam.

2.3 BACKFLOW PREVENTERS

- A. Where shown on Drawings, provide Watts 709-S-QT double check or 909-S-QT reduced pressure (RPZ) device with strainer and ball valve isolators. Provide hub drain fitting on RPZ devices.
- B. Equivalent by Febco, ITT, Zurn.

2.4 PLUMBING AIR CHAMBERS

- A. Provide Amtrol Diatrol butyl bladder type air chambers sized as per manufacturer's recommendations at all fixtures or group of fixtures. Indicate on piping fabrication drawings locations and selection.

2.5 GAS-FIRED CONDENSING WATER HEATERS

- A. Gas water heaters shall be as scheduled, manufactured by A.O. Smith. Water heater shall be of the seamless glass lined steel tank construction in which the glass coating is applied to the water side surfaces of the tank after the tank has been assembled and welded. The condensing flue coil shall be coated on the flue gas side with A.O. Smith's proprietary acid resistant glass lining designed for use in condensing heaters. Recover shall be 208 GPH at 70F temperature rise with 50 gallons of storage.
- B. The heater shall be suitable for sealed combustion direct venting with 3" diameter PVC air intake pipe and 3" diameter PVC exhaust pipe for a total distance of 50 equivalent feet of vent and 50 equivalent feet of intake. The heater shall be factory assembled and tested. The power burner shall be of a design that requires no special calibrations on start up. The heater shall be approved for 0" clearances to combustibles.
- C. The control shall be an integrated solid state temperature and ignition control device with integral diagnostics, LED fault display capability and a digital display of temperature settings.
- D. The tanks shall be foam insulated and equipped with a ASME rated temperature pressure relief valve. The water heater shall be UL listed and exceed the minimum efficiency requirements of ASHRAE/IES 90.1b-1992. Efficiency shall be 94%.
- E. Provide with domestic hot water recirculating pump, RCP-1: B&G #PL-30B, 15 GPM, 15' W.C. head, 2650max RPM, 120V. Provide with high efficiency motor, rated for constant operation.
- F. No equivalents without prior approval.

2.6 WALL HYDRANTS

- A. Wall hydrants shall be Wade series 8600L-175 concealed in cast wall box with connections for 3/4" pipe and hose. Non-freezing type with regular handle and vacuum breaker.
- B. Equivalent by J.R. Smith, Wade, Woodford or Zurn.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Equipment shall be installed per the manufacturer's recommendations.

END OF SECTION 225000

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SECTION 230500 - GENERAL PROVISIONS

PART 1 – GENERAL

1.1 SPECIFICATION FORM AND DEFINITIONS

- A. These Specifications are abbreviated form and contain incomplete sentences. Omissions of words or phrases such as "the contractor shall", "shall be", "as noted on the Drawings", "according to the drawings", "a", "an", "the" and "all" are intentional. Omitted words and phrases shall be supplied by inference.
- B. The term "Contracting Officer" wherever used in these specifications, shall mean LATIMER, SOMMERS & ASSOCIATES, P.A., 3639 SW SUMMERFIELD DRIVE, SUITE A, TOPEKA, KANSAS 66614, PHONE 785-233-3232, FAX 785-233-0647.
- C. When a word, such as "proper", "satisfactory", "equivalent", and "as directed", is used, it requires Contracting Officer's review.
- D. "Provide" means furnish and install.

1.2 LOCAL CONDITIONS

- A. Visit site and determine existing local conditions affecting work in contract.
- B. Failure to determine site conditions or nature of existing or new construction will not be considered a basis for granting additional compensation.

1.3 CONTRACT CHANGES

- A. Changes or deviations from Contract, including those for extra or additional work must be submitted in writing for review of Contracting Officer. No verbal orders will be recognized.

1.4 LOCATIONS AND INTERFERENCES

- A. Location of equipment, piping and other mechanical work is indicated diagrammatically on the Drawings. Determine exact locations on job, subject to structural conditions, work of other sections of the Specifications, access requirements for installation and maintenance and approval of Contracting Officer.
- B. Study and become familiar with the Drawings of other trades and in particular the general construction plans and details in order to obtain necessary information for figuring installation. Cooperate with work of other trades, and install work in such a way as to avoid interference with work of other trades. Minor deviations, not affecting design characteristics, performance or space limitation may be permitted if reviewed by Contracting Officer prior to installation.
- C. Any pipe, apparatus, appliance or other item interfering with proper placement of other work as indicated on Drawings, specified, or required, shall be removed and if so shown, relocated and reconnected without extra cost. Damage to new or existing work caused by Contractor shall be restored as specified for new work.
- D. Do not scale Drawings for dimensions. Accurately lay-out work from dimensions indicated on Drawings unless such be found in error.

1.5 PERFORMANCE

- A. Final acceptance of work shall be subject to the condition that all systems, equipment, apparatus and appliances operate satisfactorily as designed and intended. Work shall include required adjustment of systems and control equipment installed under this specification division.

1. Space conditions shall operate at $\pm 2^\circ$ F and $\pm 15\%$ relative humidity from setpoint.

1.6 CAD FILES

- A. Computer files (DWG) will be available from LS&A to successful bidders and manufacturers for a fee of \$100. A release of liability form will be required along with payment prior to release of files. PDF's shall be made available upon request.

PART 2 – PRODUCTS

2.1 MATERIALS, EQUIPMENT AND SUBSTITUTIONS

- A. The intent of these specifications is to allow ample opportunity for bidder to use its ingenuity and abilities to perform the work to its and the Owner's best advantage, and to permit maximum competition in bidding on standards of materials and equipment required.
- B. Material and equipment provided shall be first class quality, new, unused and without damage.
- C. In general, these specifications identify required materials and equipment by naming one or more manufacturer's brand, model, catalog number and/or other identification. The first named manufacturer or product is used as the basis for design; other manufacturers named must furnish products consistent with specifications of first named product as determined by Contracting Officer. Base bid proposal shall be based only on materials and equipment by manufacturers named, except as hereinafter provided.
- D. Where materials or equipment are described but not named, provide required items of first quality, adequate in every respect for intended use. Such items shall be submitted to Contracting Officer for review prior to procurement.
- E. Prior to receipt of bids, if Bidder wishes to incorporate products other than those named in specifications in his base bid, he shall submit a written request for review of substitutions to Contracting Officer not less than ten working days prior to bid time. Contracting Officer will review requests and acceptable items will be listed in an Addendum issued to principal bidders.
- F. Materials and equipment proposed for substitutions shall be equal to or superior to that specified in construction, efficiency utility, aesthetic design, and color as determined by Contracting Officer whose decision shall be final and without further recourse. Physical size of substitute brand shall be no larger than space provided including allowances for access for installation and maintenance. Requests must be accompanied by two copies of complete descriptive and technical data including manufacturer's name, model and catalog number, photographs or cuts, physical dimensions, operating characteristics and any other information needed for comparison.
- G. In proposing a substitution prior to receipt of bids, include in such proposal cost of altering other elements of project, including adjustments in mechanical/electrical service requirements necessary to accommodate such substitution.
- H. Within ten working days after bids are received, apparent low bidder shall submit to Contracting Officer for approval three copies of a list of all major items of equipment it intends to provide. As soon as practicable, and within 10 working days after award of Contract, submit shop drawings for equipment and materials to be incorporated in work, for Contracting Officer review. Where 10 day limit is insufficient for preparation of detailed shop drawings on major equipment or assemblies, submit manufacturer's descriptive catalog data and indicate date such detailed shop drawings will be submitted along with manufacturer's certification that order was placed within 10 working day limit.

2.2 SHOP DRAWINGS, OPERATION AND MAINTENANCE INSTRUCTIONS

- A. Submit the minimum number of shop drawings of all materials and equipment as specified in the SECTION 013300. Contracting Officer will retain one set.
 - 1. In addition, submit 1 set directly to the commissioning agent for simultaneous review.
- B. Where catalog cuts are submitted for review, conspicuously mark or provide schedule of equipment, capacities, controls, fitting sizes, etc., that are to be provided. Mark each submitted item with applicable section and paragraph numbers of these specifications, or Drawing sheet number when item does not appear in specifications. Where equipment submitted does not appear in specifications or specified equivalent, mark submittals with applicable alternate numbers, change order number or letters of authorization. Each submittal shall contain at least four sets of original catalog cuts. Each catalog sheet shall bear Equipment Manufacturer's name and address. All shop drawings on materials and equipment listed by UL shall indicate UL approval on submittal.

- C. Check all shop drawings to verify that they meet specifications and/or drawings requirements before forwarding submittals to the Contracting Officer for their review. All shop drawings submitted to Contracting Officer shall bear Contractor's approval stamp which shall indicate that Contractor has reviewed submittals and that they meet specification and Drawing requirements. Submittal review shall specifically check for but not be limited to the following: equipment capacities, physical size in relation to space allowed; electrical characteristics, provisions for supply, return and drainage connections to building systems. All shop drawings not meeting Contractor's approval shall be returned to its supplier for resubmittal.
- D. No submittals will be considered for review by the Contracting Officer without Contractor's approval stamp, or that have extensive changes made on the original submittal as a result of Contractor's review. All comments or minor notations on shop drawings shall be flagged to indicate originator of comment.
- E. Contracting Officer will not be responsible for or the cost of returning shop drawing submittals that are submitted without Contractor's review and approval stamp. A letter will be sent to Contractor by either the Contracting Officer indicating receipt of an improper submittal for pick-up by Contractor or supplier for 15 working days after date of receipt. If not picked up by the 16th working day, submittals not bearing Contractor's review and approval stamp will be disposed of by Contracting Officer.
- F. Contracting Officer's review of shop drawings will not relieve Contractor of responsibility for deviations from drawings and specifications unless such deviations have been specifically approved in writing by Owner or its representative, nor shall it relieve Contractor of responsibility for errors in shop drawings. No work shall be fabricated until Contracting Officer's review has been obtained with "no exceptions" or "as noted" language. Any time delay caused by correcting and resubmitting shop drawings will be Contractor's responsibility.
- G. Operating and Maintenance Manuals (Refer to Division 1 for additional requirements)
1. Submit an outline copy of installation, operating, and maintenance manuals for review and comment.
 2. Submit three copies of installation, operating, maintenance instructions, and parts lists for equipment provided. After receiving comments from outline review, instructions shall be prepared by equipment manufacturer.
 3. Keep in safe place, keys and wrenches furnished with equipment under the Contract. Present to Owner and obtain receipt for same upon completion of project.
 4. Prepare a complete notebook, covering systems and equipment provided. Submit notebook to Contracting Officer for review before delivery to Owner. Contractor at its option may prepare this notebook, or retain an individual to prepare it, shall include cost of this service in bid. notebook shall contain following:
 - a. Certified equipment drawings/or catalog data with equipment provided clearly marked.
 - b. Complete installation, operating, maintenance instructions and parts lists for each item of equipment.
 - c. A complete set of shop drawings.
 - d. Special emergency operating instructions with a list of service organizations (including addresses and telephone numbers) capable of rendering emergency service to various parts of mechanical system.
 - e. A complete reproducible set of project record drawings at 1/8" = 1'-0" scale showing all mechanical systems as installed.
 - f. All required warranties and guarantees.
 5. Provide brochures bound in black vinyl three-ring binders. Reinforce binding edge of each sheet of looseleaf type brochure to prevent tearing from continued usage. Clearly print on label insert of each brochure:
 - a. Project name and address.
 - b. Section of work covered by brochure, e.g. "Heating, Ventilating and Air Conditioning", and "Plumbing", etc.
- H. Furnish 1/4" = 1'-0" scale fabrication drawings for review of ductwork and piping systems to coordinate all trades prior to fabrication. Drawings shall be furnished and approved in a timely manner to avoid construction delays. These drawings must be approved prior to the ordering, fabrication, or installation of ductwork and piping. Subcontractor shall submit one set of reproducible drawings and one set of blue line prints of piping and ductwork coordination drawings. Cost of drawing preparation, printing, and distribution shall be paid for by Subcontractor and included in its base bid.

PART 3 – EXECUTION

3.1 CUTTING AND PATCHING

- A. Do cutting and patching of building materials required for installation of work herein specified. Cut no structural members without Contracting Officer's approval and in an approved manner.
- B. Patching shall be by mechanics of particular trade involved and shall meet approval of Contracting Officer.
- C. Drilling and cutting of openings through building materials requires Contracting Officer's review and approval. Make openings in concrete with concrete hole saw or concrete drill. Use of star drill or air hammer for this work is not acceptable.

3.2 MUTILATION

- A. Mutilation of building finishes, caused by demolition or installation of new work shall be repaired at Contractor's expense to approval of Contracting Officer.

3.3 SETTING, ADJUSTMENT AND EQUIPMENT SUPPORTS

- A. Work shall include mounting, alignment and adjustment of systems and equipment. Set equipment level on adequate foundation and provide proper anchor bolts and isolation as shown, specified or required by manufacturers in installation instructions. Level, shim and grout equipment bases as recommended by manufacturer. Mount motors, align and adjust drive shafts and belts according to manufacturer's instructions. Equipment failures resulting from improper installation or field alignment shall be repaired or replaced by Contractor at no additional cost to Owner.
- B. Provide floor or slab mounted equipment with 3-1/2" high concrete bases unless shown or specified otherwise.
- C. Provide each piece of equipment or apparatus on the roof, suspended from ceiling or mounted above floor level with suitable structural support, platform or carrier in accordance with best recognized practice. Verify that structural members of buildings are adequate to support equipment and unless otherwise indicated on Drawings or specified, arrange for their inclusion and attachment to building structure. Provide hangers with vibration isolators where shown on the Drawings. Submit details of hangers, platforms and supports together with total weights of mounted equipment to Contracting Officer for review before proceeding with fabrication or installation.

3.4 START-UP, CHANGEOVER, TRAINING AND OPERATIONAL CHECK

- A. Perform initial start-up of systems and equipment and shall provide necessary supervision and labor to make first seasonal changeover of systems. Personnel qualified to start-up and service this equipment, including manufacturer's technicians when specified, and Owner's operating personnel shall be present during these operations.
- B. Train Owner's operating personnel at the site to operate and maintain systems and equipment installed. Keep a record of training provided to Owner's personnel listing the date, subject covered, instructors name, names of Owner's personnel attending and total hours of instruction given each individual. Training shall be video taped for future use by the Owner. Submit two copies on all tapes to Owner. Refer to 01651 for additional requirements.

3.5 PRE-FINAL AND FINAL CONSTRUCTION REVIEW

- A. At Contractor's request, Contracting Officer will make pre-final construction review to determine if to the best of its knowledge project is completed in accordance with Contract Documents.
 - 1. Items found by Contracting Officer as not complete or not in accordance with requirements of contract will be outlined in report to Contracting Officer for forwarding to Subcontractors. Subcontractor shall complete and/or correct these items, before notifying Contracting Officer it is ready for final review.
- B. All necessary system adjustments, including air systems balancing, shall be completed and all specified records and reports submitted in sufficient time to be received by Contracting Officer at least ten working days prior to date of final construction review.

- C. At final construction review, Contractors shall be present or shall be represented by a person of authority. Each shall demonstrate, as directed by Contracting Officer, that work complies with purpose and intent of contract documents and shall provide labor, services, instruments or tools necessary for such demonstrations and tests.

3.6 WALL PENETRATIONS

- A. Include the installation of all boxes, access panels and sleeves for openings required to install the work. All floor and wall penetrations shall be sealed to meet fire rating requirements using materials tested in accordance with ASTM E814.

3.7 OPENINGS, ACCESS PANELS & SLEEVES

- A. Include the installation of all boxes, access panels and sleeves for openings required to install this work, except structural openings incorporated in the structural drawings. Sleeves shall be installed for all pipes passing through structural slabs and walls. Set and verify the location of sleeves as shown on structural plans that pass through beams, only if so shown. All floor and wall penetrations be sealed to meet fire rating requirements. Access panels shall include those required to access fire dampers, VAV boxes, valves, smoke dampers, pipe chases, manual and automatic dampers, etc. Locations and sizes of panels are to be determined by the contractor and are not specifically shown on the drawings.

END OF SECTION 230500

SECTION 230501 - EXTENT OF CONTRACT WORK AND CODES

PART 1 - GENERAL

1.1 GENERAL EXTENT OF WORK INCLUDED

- A. Provide mechanical systems indicated on Drawings, specified or reasonably implied. Provide every device and accessory necessary for proper operation and completion of mechanical systems. In no case will claims for "Extra Work" be allowed for work about which Contractor could have been informed before bids were taken.
- B. Become familiar with equipment provided by other Subcontractors which require mechanical connections and controls.
- C. Electrical work required to install and control mechanical equipment which is not indicated on Drawings or specified under Division 26 shall be included.
- D. The cost and provision of larger wiring, conduit, control, and protective devices resulting from installation of equipment which was not used for basis of design as outlined in specifications shall be provided at no increase in contract price.
- E. Provide supervision to subcontractor to insure that required connections, interlocking and interconnection of mechanical and electrical equipment are made to attain intended control sequences and system operation.
- F. Furnish six complete sets of electrical wiring diagrams to Contracting Officer and three complete sets to Electrical Subcontractor. Diagrams shall show factory and field wiring of components and controls. Control devices and field wiring to be provided by Electrical Subcontractor shall be clearly indicated by notation and drawing symbols on wiring diagrams.
- G. Obtain complete electrical data on mechanical shop drawings and list this data on an approved form which shall be presented monthly or on request, to Electrical Subcontractor. Data shall be complete with wiring diagrams received to date and shall contain necessary data on electrical components of mechanical equipment such as HP, voltage, amperes, watts, locked rotor current to allow Electrical Subcontractor to order electrical equipment.

1.2 CODES, RULES AND REGULATIONS

- A. Conform to latest editions and supplements of following codes, standards or recommended practices.
 - 1. International Plumbing Code-2006.
 - 2. International Mechanical Code-2006.
 - 3. International Uniform Building Code-2003.
 - 4. National Electrical Safety Code Handbook H30 - 2002 - National Bureau of Standards.
 - 5. Occupational Safety and Health Standard (OSHA) - Department of Labor.
 - 6. NFPA No. 54 Gas Appliance & Gas Piping Installation
 - 7. NFPA No. 70 National Electrical Code-2002
 - 8. NFPA No. 90A Air Conditioning and Ventilating Systems
 - 9. NFPA No. 91 Blower & Exhaust System
 - 10. International Fuel Gas Code -2000.
 - 11. International Fire Code - 2000
 - 12. ANGETL 01-1-1, March 2004

1.3 DRAWINGS

- A. Drawings are to be considered diagrammatic for all systems. All plumbing fixtures require waste, water and vent connections and they should be provided. Any plumbing vents, relief air openings, flues, exhaust openings, etc. must be placed 10'-0" from any outside air intakes. Piping and drawings do not show all required offsets and fittings. Contractor shall include in bid costs to provide systems which will avoid and coordinate will all other building trades and systems.

1.4 TEMPORARY UTILITIES

- A. Contractor shall provide temporary utilities at their cost during construction.

1.5 COMMISSIONING - C.A. REQUIREMENTS

- A. Refer to Section 01651 for contractor requirements for Commissioning and start-up. All systems and equipment are to be commissioned unless specifically excluded in Section 01651.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 UTILITIES

- A. Contract and coordinate the installation of utility services for this structure immediately after notice to proceed. Any discrepancies between the needs of the utility providers and the contract documents should be brought to the attention of the Contracting Officer.

END OF SECTION 230501

SECTION 230503 - BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 REQUIRED WORK

- A. Provide the reasonable use of temporary HVAC systems, testing and identification as specific below.

PART 2 – PRODUCTS

2.1 PIPING IDENTIFICATION

- A. Identify piping in mechanical rooms and 20'-0" maximum spacing in all other accessible areas with Seaton setmark pipe markers with letters (min. 1" high) and flow direction arrows. Colors and wording shall be of standard pipe markers as available from Seaton or equal. Submit for approval list of colors and wording prior to purchase of pipe markers. Pipe markers shall meet applicable ANSI Standard and OSHA requirements.

2.2 VALVE IDENTIFICATION

- A. Mark all valves with Seaton No. 300-BL brass identification tags with system legend, valve number and size stamped on tag. Lettering shall be black 1/2" high. Tags shall be minimum 2" in diameter and attached to valve with Seaton No. 16 brass jack chain.
- B. Prepare four copies of typewritten list of valve tags. List shall be typed in upper case and contain tag number, valve size, type, function and location. Frame one list under glass and mount near operating instruction in main equipment rooms.

PART 3 – EXECUTION

3.1 EXCAVATION AND BACKFILL(REFER TO DIVISION 2 FOR ADDITIONAL REQUIREMENTS)

- A. Perform necessary excavation to receive Work. Provide necessary sheathing, shoring, cribbing, tarpaulins, etc. for this operation, and remove same at completion of work. Perform excavation in accordance with appropriate section of these specifications, and in compliance with OSHA Safety Standards.
- B. Excavation
 - 1. Excavate trenches of sufficient width to allow ample working space, and no deeper than necessary for installation work.
 - 2. Conduct excavations so no walls or footings are disturbed or injured. Backfill excavations made under or adjacent to footing with lean concrete.
- C. Backfill trenches and excavations to required heights with allowance made for settlement. Tamp fill material thoroughly and moistened as required for specified compaction density. Dispose of excess earth, rubble and debris as directed by Contracting Officer.

3.2 TESTING PROCEDURES FOR PIPING SYSTEMS

- A. Test all lines and systems before they are insulated, painted or concealed by construction or backfilling. Provide fuel, water, electricity, materials, labor and equipment required for tests.
- B. Where entire system cannot be tested before concealment, test system in sections. Upon completion, each system shall be tested as an entire system.
- C. Repair or replace defects, leaks and material failures revealed by tests and then retest until satisfactory. Make repairs with new materials.
- D. Verify that system components are rated for maximum test pressures to be applied. Where specified test pressures exceed component ratings remove or isolate components from system during tests.

3.3 TEST METHODS AND PRESSURES

- A. Submit test forms in advance of testing and coordinate test observations with the Owner and Commissioning Agent prior to tests.
- B. Test methods and pressures shall be as follows:

1. System Test:
 - a. Test entire system with product conveyed. Systems operating above 25 PSI shall be tested at 75 PSI or 150% of operating pressure or whichever is greater.
 - b. Allow at least 1 hour after test pressure has been applied before making initial test.
 2. Refrigerant Test:
 - a. Leak check completed systems first with a small amount of the proper refrigerant to be used with the pressure of this gas boosted with dry nitrogen to a pressure of 150 psig. Perform leak test with an appropriate electronic tester.
 - C. All systems shall hold scheduled test pressures for specified time without loss of initial test pressure.
 - D. Upon completion of testing submit five copies of a typewritten report to Contracting Officer. Report shall list systems tested, test methods, test pressures, holding time and all failures with corrective action taken.
- 3.4 STERILIZATION OF DOMESTIC WATER SYSTEMS
- A. After final pressure testing of distribution system thoroughly flush entire system with water until free of dirt and construction debris. Fill system with solution of liquid chlorine or hypochlorite of not less than 50 PPM. Retain treated water in system until test indicates non-spore-forming bacteria have been destroyed or for 24 hours whichever is greater.
 - B. All points in systems shall have at least 10 PPM of solution at end of retention period. Open and close each valve at least six times in system during sterilization process to sterilize valve parts.
 - C. When time and concentration conditions have been met, drain system and flush with fresh domestic water until residual cleaning solution is less than 1.0 PPM. Open and close each valve in system six times during flushing operation.
 - D. Test samples taken from several points in shall indicate absence of pollution for two full days. Repeat sterilization as required. Acceptance of system will not be given until satisfactory bacteriological results are obtained.
- 3.5 CLEANING OF SYSTEMS AND EQUIPMENT
- A. After pressure testing of systems and equipment and before operational test thoroughly clean interiors of piping and equipment. Clean equipment as recommended by equipment manufacturers. Keep a log of pressure drops, blowdown, and strainer removal tracking the cleaning process. Where specific instructions are not provided, clean equipment systems as follows:
 1. Hot and chilled water piping and components: Fill system with a solution of 1 pound caustic soda or 3 pounds of trisodium phosphate per 100 gallons of water. Heat system water to 150 degrees F and circulate for 48 hours before draining system. Flush system thoroughly with fresh water before refilling with treated water. Treat system water as specified under Section 232500.
 2. Boilers: Remove relief valve from boiler and close steam or water supply line from boiler. Provide pipe connection from relief valve taping to drain or to atmosphere if steam boiler. Fill boiler with a solution of caustic soda and water at a rate of 1 pound of caustic soda per 5 HP of boiler rating. Fire boiler for 5 hours and maintain constant boiler water level. Drain boiler while still warm flush interior surfaces of boiler from top to bottom with clean water from high pressure hose. Flush until water leaving boiler is clear. Repeat boiling process as required to properly clean boiler. Water boilers shall be cleaned prior to cleaning piping systems. Water boilers shall be drained and flushed after piping system has been cleaned. Boiler water shall be treated as specified under section 232500.
 3. Air Handling Systems: Before starting any air system clean all debris, foreign matter and construction dirt from air system and fan. Provide equipment requiring filters, such as air handling units, fan coil units, blower, etc., with throw-away filters. After cleaning air system install temporary filters and run continuously for a minimum of eight hours at full volume before installing permanent filters. Provide temporary throw-away filters in all permanent heating and air conditioning equipment systems being utilized during construction. Prior to testing and balancing systems, remove temporary filter media and install clean unused filters of the type specified. Clean filters shall be installed in equipment for final acceptance inspection by Contracting Officer.

3.6 MAINTENANCE OF SYSTEMS

- A. Subcontractor shall be responsible for operation, maintenance and lubrication of equipment installed under this contract. During testing and demonstration period and for entire period of temporary use during construction.
- B. Keep a complete record of equipment maintenance and lubrication and submit two copies with request for final construction review.
- C. Records shall indicate types of lubricants used and date or time when next maintenance or lubrication will need to be performed by Owner. Where special lubricants are required, Subcontractor shall provide Owner with a one year supply as determine by equipment manufacturer's recommendations.

3.7 PAINTING OF MATERIALS AND EQUIPMENT (INITIAL INSTALLATION)

- A. Painting including touch-up and refinishing of factory applied finish upon initial installation shall be by Subcontractor. Subcontractor shall be responsible for obtaining proper type of painting materials and color from equipment manufacturer.
- B. Mechanical equipment and materials shall be painted as specified and scheduled under Division 9.
- C. Omit painting of piping, insulation, and materials located in chases, concealed tunnels and where concealed above ceilings. Where these locations occur in damp or humid environments prime ferrous metal to prevent rust and corrosion.
- D. Unless specified otherwise factory built equipment shall be factory painted. Paint shall be applied over surfaces only after they have been properly cleaned and coated with a corrosion resistant primer.
- E. After installation, damage to painted surfaces shall be properly prepared and primed with primers equal to factory materials. Finish coating shall be same color and type as factory finish.
- F. Where extensive refinishing is required equipment shall be completely repainted.

3.8 FIRE STOPPING

- A. All holes or voids created by the mechanical Subcontractor to extend pipe through fire rated floors and walls and shall be sealed with an intumescent material capable of expanding up to 8 to 10 times when exposed to temperatures of 250 degrees F. It shall be ICBO, BOCAI and SBCCI (NRB 243) approved ratings to 3 hours per ASTM E-814 (UL 1479). Acceptable Material: 3M Fire Barrier Caulk, putty, strip and sheet forms. Equivalent by SpecSeal.
- B. Submit for review firestopping methods and sleeve drawings indicating all required application, methods and sleeves. Refer to Architectural drawing for locations of fire rated partitions and floors.

3.9 USE OF PERMANENT HVAC SYSTEM FOR TEMPORARY HEAT

- A. Provide the use of permanent heating and cooling systems for temporary construction conditioning. Systems shall only be used once permanent power is installed and the following guidelines are confirmed in writing prior to start-up.
 - 1. Systems meet the requirements for permanent and temporary use for all involved manufacturers.
 - 2. Temporary cartridge filters and fabric throwaway pre-filters are installed on all equipment and all ductwork openings.
 - 3. Filters shall be monitored daily and charged at least weekly.
 - 4. Duct and AHU systems shall be inspected weekly to confirm no construction dust or debris is entering the system.
 - 5. Piping systems have been thoroughly flushed, cleaned and treated.
 - 6. Proper combustion air exists for gas-fired boilers or water heater.
 - 7. Air handling systems are turned off during heavy gyp. board sanding and painting.
- B. At the completion of construction, all duct systems and air handling equipment must be clean. Systems which are not determined acceptable to the A-E shall be re-cleaned.
- C. All systems, whether used for temporary construction conditioning or not, shall have a 1 year warranty from the date of substantial completion, irregardless of start-up date.

- D. Contractor shall make arrangements for all necessary power or natural gas to operate equipment during construction and shall include in bid all utility costs for such use.

END OF SECTION 230503

SECTION 230510 - SEISMIC PROTECTION

PART 1 - GENERAL

1.1 GENERAL

Note: The requirements for seismic protection measures to be applied to mechanical/electrical equipment and systems specified herein are in addition to any other items called for in other sections of these specifications.

- A. Seismic protection for mechanical equipment and components shall be provided by the Mechanical Contractor.
- B. Seismic protection for electrical equipment and components shall be provided by the Electrical Contractor.
- C. Seismic protection for general construction items, including suspended ceilings, shall be provided by the General Contractor.

1.2 MECHANICAL/ELECTRICAL EQUIPMENT

- A. Mechanical/electrical equipment shall include the following items to the extent required on plans or in other sections of these specifications:

- Boilers
- Expansion Tanks
- Water Chiller Units
- Control Panels
- Pumps with Motors
- Light Fixtures
- Motor Control Centers
- Switchboards (Floor Mounted)
- Suspended Ceiling Assemblies
- Water and Gas Piping Drain, Waste and Vent Piping
- Air and Refrigerant Compressors
- Air Handling Units
- Switchgear
- Transformers
- Ducts

1.3 MECHANICAL SYSTEMS

- A. Mechanical systems shall include the following items to the extent required on plans or in other sections of these specifications:

- Hot Water Distribution Systems
- Chilled Water Distribution Systems
- Gas Distribution Systems
- Water Supply Systems
- Sanitary Sewer Systems
- Fire Sprinkler Systems

1.4 ZONE

- A. This facility is located in Seismic Zone No. 2A.

1.5 EXCLUSION

- A. Piping and ducts that do not require special seismic restraints: Seismic restraints may be omitted from the following installations:
 - 1. Gas piping less than 1-inch inside diameter.
 - 2. Piping in boiler and mechanical equipment rooms less than 1-1/4 inches inside diameter.
 - 3. All other piping less than 2-1/2 inches inside diameter.
 - 4. All electrical conduit less than 2-1/2 inches inside diameter.
 - 5. All rectangular air handling ducts less than 6 square feet in cross sectional area.
 - 6. All round air handling ducts less than 28 inches in diameter.

7. All piping suspended by individual hangers 12 inches or less in length from the top of pipe to the bottom of the support for the hanger.
8. All ducts suspended by hangers 12 inches or less in length from the top of the duct to the bottom of the support for the hanger.

1.6 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of support and anchor. Submit pipe hanger and support schedule showing Manufacturer's figure number, size, location, and features for each required pipe hanger and support.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawings for each type of support and anchor, indicating dimensions, weights, required clearances, and methods of assembly or components.
- C. Maintenance Data: Submit maintenance data and parts lists for each type of support and anchor. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 1.
- D. Shop drawings, along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed below shall be submitted in accordance with the SPECIAL CLAUSES. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction.

Sway Braces
Flexible Couplings or Joints
Resilient Type Vibration Devices
Smoke Stacks

PART 2 – PRODUCTS

2.1 MATERIALS AND EQUIPMENT SHALL CONFORM TO THE RESPECTIVE SPECIFICATIONS AND OTHER REQUIREMENTS SPECIFIED BELOW:

2.2 BOLTS AND NUTS

- A. Squarehead bolts and heavy hexagon nuts, ANSI B18.2.1 and B18.2.2, and ASTM A 307 or A 576.
- B. Bolts, underground, ASTM A 325.

2.3 SWAY BRACE

- A. Material used for members listed in Appendix of this specification, except for pipes, shall be structural steel conforming with ASTM A 36. Steel pipes shall conform to ASTM A 501.

2.4 FLEXIBLE COUPLINGS

- A. Flexible couplings shall have same pressure ratings as adjoining pipe.
- B. Flexible ball joints conforming to the following requirements may be employed on aboveground piping. Joints shall have cast or wrought steel casing and ball parts capable of 360-degree rotation plus not less than 15-degree angular movement. Joints shall be certified to be suitable for the service intended by the manufacturer, based on not less than 2 years' satisfactory operation in a similar application.
- C. Flexible couplings and joints of the mechanical joint type may be used for aboveground or underground piping.
- D. Mechanical couplings for steel or cast iron pipe shall be of the sleeve type and shall provide a tight flexible joint under all reasonable conditions, such as pipe movement caused by expansion, contraction, slight settling or shifting of the ground, minor variations in trench gradients, and traffic vibrations. Where permitted in other sections of these specifications, joints utilizing split-half couplings with grooved or shouldered pipe ends may be used.
- E. Sleeve-type couplings shall be used for joining plain-end pipe sections. The coupling shall consist of one steel middle ring, two steel followers, two gaskets, and necessary steel bolts and nuts to compress the gaskets. Underground bolts shall be high-strength type as specified above.
- F. Guy Wires: Guy wires shall conform to Fed. Spec. RR-W-410 as follows:

5/32 inch diameter	Type V, Class 1
3/16 inch to 5/16 diameter	Type V, Class 2
1/4 inch to 5/8 diameter	Type I, Class 2

PART 3 – EXECUTION

3.1 SWAY BRACES

- A. Sway braces shall be installed on piping and duct to preclude damage during seismic activity. All bracing shall conform to the arrangements shown. Provisions of this paragraph apply to all piping within a 5-foot line around outside of building unless buried in the ground. Piping grouped for support on trapeze-type hangers shall be braced at the same intervals as determined by the smallest diameter pipe of the group. No trapeze-type hanger shall be secured with less than two ½-inch bolts. Bracing rigidity attached to pipe flanges, or similar, shall not be used where it would interfere with thermal expansion of piping.

3.2 SWAY BRACES FOR PIPING

- A. Transverse Sway Bracing: Transverse sway bracing shall be provided at intervals not to exceed those given in Appendix of this section except for cast iron soil pipe, which shall be braced at not more than 10-foot intervals.
- B. Longitudinal Sway Bracing: Longitudinal sway bracing shall be provided at 40-foot intervals.
- C. Vertical Runs: Vertical runs of piping shall be braced at not more than 10-foot vertical intervals. For small tubing, bracing shall be provided at no more than 4-foot spacing.
- D. Anchor Rods, Angles, and Bars: Anchor rods, angles and bars shall be bolted to either pipe clamps or pipe flanges at one end and cast-in-place concrete or masonry insert or clip angles bolted to the steel structure on the other end. Rods shall be solid metal or pipe as specified below. Anchor rods, angles, and bars shall not exceed lengths given in Appendix of this section.
- E. Clamps on uninsulated pipes shall be applied directly to pipe. Insulated piping shall have clamps applied over insulation vapor barrier with high-density inserts and metal protection shields under each clamp.
- F. Bolts: Bolts used for attachment of anchors to pipe and structure shall be not less than ½-inch diameter.

3.3 SWAY BRACES FOR DUCTS

- A. Transverse Sway Bracing: Transverse sway bracing shall be provided at each horizontal turn of 45 degrees or more, at the end of each duct run, and otherwise at each 30-foot interval. Walls which ducts penetrate may be considered transverse braces.
- B. Longitudinal Sway Bracing: Longitudinal sway bracing shall be provided at 60-foot intervals. Transverse bracing for one duct section may also act as longitudinal bracing for a duct section connected perpendicular to it, if the bracing is installed within 4 feet of the intersection, and it is sized for the larger duct.
- C. Bracing Angles: Bracing angles for rectangular ducts shall be in accordance with Appendix of this section.

3.4 SPREADERS

- A. Spreaders shall be provided between racked or adjacent piping runs to prevent contact during seismic activity whenever pipe or insulated pipe surfaces are less than 4 inches apart or four times the maximum displacement due to seismic force. Spreaders to be applied at same interval as sway braces. Spreaders shall be applied to surface of bare or insulated hot pipe and over insulation utilizing high-density inserts and pipe protection shields where vapor-barrier-type insulation is employed.

3.5 FLEXIBLE COUPLINGS OR JOINTS

- A. Building Piping: Flexible couplings or joints in building piping shall be provided at bottom of all pipe risers larger than 3-1/2 inches in diameter, except thermal heat distribution piping.
- B. Cast iron waste and vent piping need only comply with these provisions when caulked joints are used. Flexible bell and spigot pipe joints using rubber gaskets or no-hub fittings may be used at each branch adjacent to tees and elbows for underground waste piping inside of building to comply with these requirements.
- C. Underground Piping: All underground piping and 4-inch or larger conduit, except thermal heat distribution system, shall have flexible couplings installed adjacent to building as shown. Additional flexible couplings shall be provided as follows:

1. On each side of the joints of demarkation between soils having widely differing degrees of consolidation.
2. At all points that can be constructed to act as anchors.
3. On every branch of a tee and each side of an elbow.

3.6 ANCHOR BOLTS

- A. All floor or pad mounted equipment required by any Section of these specifications shall be rigidly fastened to the floor or pad by use of cast-in-place anchor bolts. Anchor bolts must conform to ASTM A 307. Anchor bolts shall have an embedded straight length equal to or at least 12 times nominal diameter of the bolt. If the size and number of the anchor bolts are not shown on the drawings then anchor bolts shall be ½" in diameter or the manufacturer's installation recommendations, whichever is the most stringent.
- B. Four bolts per item shall be provided with a minimum embedment of 12 bolts diameters, a minimum bolt spacing of 16 bolts diameters and a minimum edge distance of 12 bolts diameters. Anchor bolts that exceed normal depth of equipment foundation piers or pads shall either extend into concrete floor or the foundation shall be increased in depth to accommodate bolt lengths.
- C. Expansion anchors shall not be used to resist seismic or vibratory loads unless test data are provided to verify the adequacy of the specific anchor and application. In no case shall the expansion anchor size be less than that required for bolts in the preceding table.

3.7 RESILIENT VIBRATION ISOLATION DEVICES

- A. Selection of anchor bolts for vibration isolation devices and/or snubbers to equipment base and foundations shall follow the same procedure as in paragraph ANCHOR BOLTS except that an equipment weight equal to five times the actual equipment weight shall be used.
 1. Resilient and Spring-Type Vibration Devices: Vibration isolation devices shall be selected so that the maximum movement of equipment from the static deflection point shall be 0.5 inches.

3.8 EQUIPMENT SWAY BRACING

- A. Equipment sway bracing shall be provided for all items supported from overhead floor or roof structures. Braces shall consist of angles, rods, bars, or pipes arranged as shown and secured at both ends with not less than ½-inch bolts. Bracing shall be provided in two planes of directions, 90 degrees apart, for each item of equipment. Details of all equipment bracing shall be submitted for approval. In lieu of bracing with vertical supports, these items may be supported with hangers inclined at 45 degrees directed up and radially away from equipment and oriented symmetrically in 90 degree intervals on the horizontal plane, bisecting the angles of each corner of the equipment, provided that supporting members are properly sized to support operating weight of equipment when hangers are inclined at a 45 degree angle.

3.9 LIGHTING FIXTURES IN BUILDINGS

- A. In addition to the requirements of the preceding paragraphs, lighting fixtures and supports will conform to the following:
- B. Materials and Construction:
 1. Fixture supports shall be malleable iron.
 2. Loop and hook or swivel hanger assemblies for pendant fixtures shall be fitted with a restraining device to hold the stem in the support position during earthquake motions. Pendant-supported fluorescent fixtures shall also be provided with a flexible hanger device at the attachment to the fixture channel to preclude breaking of the support. The motion of swivels or hinged joints shall not cause sharp bends in conductors or damage to insulation.
 3. Recessed fluorescent individual or continuous-row fixtures shall be supported by a seismic-resistant suspended ceiling support system and shall be provided with fixture support wires attached to the building structural members using two wires for individual fixtures and one wire per unit of continuous row fixtures.
 4. A supporting assembly that is intended to be mounted on an outlet box shall be designed to accommodate mounting features on 4-inch boxes, 3-inch plaster rings, and fixture studs.

5. Surface-mounted fluorescent individual or continuous-row fixtures shall be attached to a seismic-resistant ceiling support system. Fixture support devices for attaching to suspended ceilings shall be a locking-type scissor clamp or a full loop band that will securely attach to the ceiling support. Fixtures attached to underside of a structural slab shall be properly anchored to the slab at each corner of the fixture.
 6. Each wall-mounted emergency light unit shall be secured in a manner to hold the unit in place during a seismic disturbance.
- C. Tests: In lieu of the requirements for equipment supports, lighting fixtures and the complete fixture-supporting assembly may be tested as specified hereinafter. Such tests shall be conducted by an approved and independent testing laboratory, and the results of such tests shall specifically state whether or not the lighting fixture supports satisfy the requirements given herein.
1. Test Equipment: To simulate earthquake motion, fixtures and supports shall be attached to a carriage suspended on rollers from an overhead track. A gear motor and crank assembly shall be used to provide oscillatory motion of approximately one cycle per second. The exact number of cycles per second and the actual dimensions of the crank apparatus shall be adjusted to produce a minimum carriage acceleration of 0.14g. The actual fixture-mounting surface shall be on the underside of the carriage and shall provide capacity for orienting the fixture in a horizontal plane in various positions, ranging from parallel to perpendicular to the line of traverse.
 2. Test Requirements: All tests shall be conducted with the maximum fixture weight so as to produce the most severe loading conditions. Fixtures having stems shall be tested with the actual stem lengths to be used. Tests shall be of 1-minute duration with the mounting surface in the line of traverse, at 45 degrees to the line of traverse, and at 90 degrees to the line of traverse. A total of two fixtures shall be tested in each of the above positions. After each of the six tests, the complete stem assemblies from fixtures having stem assemblies shall be subjected to a tensile strength test. The sample shall withstand, without failure, a force of not less than four times the weight it is intended to support.
 3. Acceptance: No component of a fixture nor its support shall be accepted individually. For acceptance, the fixture and its supports shall exhibit no undue damage, and no component of the fixture shall fail or fall from the fixture during testing.
- D. Design Criteria: In lieu of the above test requirements, lighting fixtures shall be designed to resist a lateral force of 56 percent of the fixture weight.
- E. Lighting Fixtures and Air Diffuser Supports: Lighting fixture and air diffuser supports shall be designed and installed to meet the requirements of equipment supports in the preceding paragraphs of this specification with the following exceptions:
1. Recessed lighting fixtures not over 56 pounds in weight and suspended and pendent-hung fixtures not over 20 pounds in weight may be supported and attached directly to the ceiling system runners by a positive attachment such as screws or bolts.
 2. Air diffusers that weigh not more than 20 pounds and that receive no tributary loading from ductwork may be positively attached to and supported by the ceiling runners.

3.10 SMOKE STACKS

- A. Stack shall be mounted directly on boilers or heat producing appliances or on floor supporting such devices with side inlets to stacks. All stacks must be supported with steel guys attached to a point three-fourths of the stack height external to the building. Guy wires shall be 1/4" 6 x 19 cable, improved plow steel with fiber core, as noted, with galvanized coating.

3.11 MISCELLANEOUS EQUIPMENT

- A. The following specific items of equipment to be furnished under this contract shall be constructed and assembled so as to be capable of withstanding the horizontal equivalent static force of 0.11 times the operating weight of the equipment, at vertical center of gravity of the equipment without causing permanent deformation, dislocations, separation of components, or other damage, which would render the equipment inoperative for significant periods of time following an earthquake.

3.12 MISCELLANEOUS EQUIPMENT

Boilers
Cooling Tower
Air-Handling Units
Transformers
Switchboards and Switchgears
Motor Control Centers
Free Standing Electric Motors

3.13 APPENDIX

- A. The following are reproductions from SMACNA Seismic Restraint Manual Chapters 4, 7 and 8 and contain details for duct, pipe conduit and equipment seismic restraint and shall be used for determining the required restraint for this project. The building shall be categorized seismic hazard level "C".

END OF SECTION 230510

SECTION 230513 - ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 COORDINATION

- A. The cost of larger wiring, conduit, control and protective devices resulting from installation of equipment that was not used for basis of design as outlined in Section 230500 of specifications shall be paid for by Contractor at no cost to Owner or Contracting Officer.
- B. Provide coordination such that required connections, interlocking and interconnection of mechanical and electrical equipment are made to attain intended control sequences and system operation.
- C. Furnish six complete sets of electrical wiring diagrams. Diagrams shall show factory and field wiring of components and controls. Required Control devices and field wiring shall be clearly indicated by notation and drawing symbols on wiring diagrams.
- D. Safety disconnect switches and manual and magnetic motor starters shall be provided.

PART 2 – PRODUCTS

2.2 ELECTRIC MOTORS 1/3 HP AND SMALLER

- A. Motors 1/3 horsepower and smaller shall be Century, General Electric or Westinghouse of type and NEMA frame selected by manufacturer of driven equipment with motor speed and torque characteristics best suited for application.
- B. Motors shall have a minimum service factor of 1.15 for open drip proof enclosure and 1.00 for totally enclosed motors.
- C. Provide motors with cushion bases. Motor enclosure shall be proper type required for operating environment.
- D. Motors shall have a plus or minus 10% voltage tolerance and plus or minus 5% frequency tolerance. Motors shall operate satisfactorily in ambient temperature range of 9 degree C (32 degrees F) to 40 degrees C (104 degrees F) at altitudes below 3300 feet.
- E. Provide motors with built-in thermal overload protection. Motors readily accessible to operating personnel shall have manual reset protector. All others shall have automatic reset protectors.
- F. Motors shall have AFBMA standard double-shielded ball bearings sized for average life of at least 100,000 hours under normal loading conditions. Bearings housing shall have provisions for adding new lubricant without major motor disassembly and shall have seals to prevent entrance of foreign matter and leakage of bearing lubricant.
- G. Motor bolts, screws and other external hardware shall be treated with a corrosion resistant plating and motor enclosure prime painted with corrosion resistant metal primer finished with durable machinery enamel.
- H. Unless indicate otherwise motors shall be rated for continuous operation at 115, 200 or 460 volts single phase, 60 hertz. Where equipment manufacturer offers a choice provide permanent split capacitor motors in lieu of shade pole motors.
- I. Motor leads shall be marked throughout entire length for easy identification and terminated with brass or copper terminal lugs. Motor shall have permanently attached nameplate with electrical characteristics and wiring connection diagram.

2.2 ELECTRIC MOTORS (1/2 HP AND LARGER)

- A. Provide equipment requiring electric motors with NEMA Standard motors manufactured by Allis Chalmers, Century, General Electric or Westinghouse. Shop drawings submitted on equipment provided with electric motors shall include motor manufacturer, horsepower, voltage, full load amperes, NEMA design type, insulation class, shaft bearing type, mounting base type, and enclosure type. Motors for this project shall be by one manufacturer.
- B. Motors shall conform to current NEMA Standard MG1. Motor shall operate successfully without derating under the following conditions:
 - 1. 40 degrees C (104°F) maximum ambient temperature.

2. 3,300 ft. maximum altitude.
 3. Voltage variations of plus or minus 10% of nameplate rating.
 4. Frequency variations of plus or minus 5% of nameplate rating.
 5. Combined voltage and frequency variation of plus or minus 15% total as long as frequency does not exceed plus or minus 5%.
- C. Motors shall meet or exceed locked rotor (starting) and breakdown (maximum torques specified) for the NEMA design rating. Lock rotor currents shall not exceed NEMA maximum values for motor NEMA design rating.
- D. Unless indicated otherwise motor insulation may be manufacturers standard for Class A, B or F provided that maximum permissible temperature for insulation is not exceeded when motor is operating at its service factor load in at 40 degree C (104°F) ambient.
- E. Motor service factors shall be 1.15 for open dripproof motors and 1.00 for totally enclosed motors.
- F. Motor frame/HP relationship shall conform to current NEMA standard for "T" frames. Motors shall have antifriction ball or roller bearings sized for average life of at least 100,000 hours under normal V-belt loading conditions. Bearings shall be AFBMA Standard end shield mounted ball bearings of ample capacity for motor rating. Bearing housing shall have provisions for adding new lubricant and draining out old lubricant without major motor disassembly. Bearing housing shall have seals to protect bearing from entrance of foreign matter and to prevent leakage of bearing lubricant.
- G. Conduit box mounting shall rotate to allow conduit entrance from top, bottom or either side. Conduit holes shall conform to NEC Standards.
- H. Motor leads shall have same insulation class as motor windings. Leads shall be marked throughout entire length for easy identification and terminated with brass or copper terminal lugs. Motor shall have permanently attached nameplate with electrical characteristics and wiring connection diagram.
- I. Motor bolts, screws and other external hardware shall be treated with a corrosion resistant plating. Motor enclosure shall be prime painted with corrosion resisting metal primer and finished with a durable machinery enamel.
- J. Unless indicated otherwise motors 1/2 horsepower and larger shall be rated for continuous operation at 208 volts, one phase or three phase, 60 hertz. Motors shall be T-frame squirrel cage induction. Type NEMA design B with Class B insulation. Motors shall be drip proof, totally enclosed or explosion proof as required by motor environment.

PART 3 – EXECUTION (NOT APPLICABLE)

END OF SECTION 230513

SECTION 230519 - THERMOMETERS AND GAUGES

PART 1 – GENERAL

1.1 THERMOMETERS AND GAUGES

- A. Provide thermometers and wells, and pressure test plugs as hereinafter specified and shown on the plans and so that proper testing and balancing and trouble shooting can be accomplished.

PART 2 – PRODUCTS

2.1 THERMOMETERS

- A. Thermometers shall be red reading non-mercury type having scale length of not less than 9", and scale divisions of 2 degrees F, or less similar and approved equal to Moeller Instrument Company, Inc., Style AJ. Range shall be as specified or as required for the duty. Thermometers and wells must be of at least the quality and design specified. Equipment manufactured by one of the following manufacturers will be acceptable: Moeller, Terrice or Weksler.

2.2 GAUGES

- A. Gauges shall be bourdon tube with minimum 4-1/2" dial and die cast aluminum case with black enamel finish. The movement shall be all stainless steel with Grade A phosphor bronze bourdon tube brazed at socket and tip. The accuracy of the gauge shall be within 1/2 percent of the scale range. The pointer shall be the micrometer adjustment type recalibrated from the front. Pressure, compound, and differential pressure gauges shall have suitable scale ranges, shall be submitted and are subject to the review of the Contracting Officer. Graduations shall be one pound or less on all gauges where this is standard for the required range.
- B. Gauges shall have 1/4" IPS connections and shall be Moeller "Vantage" gauges with Case Style No. 2, or approved equal. Equipment manufactured by one of the following manufacturers will be acceptable: Ashcroft, Marsh, Terrice, Moeller, Weksler, Taylor, Weiss, or Midwest.

PART 3 – EXECUTION

3.1 THERMOMETERS

- A. Thermometers shall have the temperature ranges to match the systems installed.
- B. Provide pressure or temperature test plugs at supply and return to all coils and as indicated on the drawings. Taps shall be Pete's Plug, 1/2" NPT, brass with Nordel core, Model 710, or approved equal.

3.2 GAUGE TEST COCKS AND GAUGES

- A. Gauge test cocks shall be installed on the suction and discharge piping for each water circulating pump, and at locations as indicated on the drawings.

3.3 Schedule

THERMOMETER & TEST GAUGE COCK INSTALLATION SCHEDULE

	Thermometer & Gauge Cock	Press Gauge	Pete's Plug & Well
Suction and discharge flange of each pump			X
Water entering and leaving all AHU coils	X		X
Domestic hot water Leaving water heaters	X		X
Entering & Leaving Boilers	X	X	X
Entering and Leaving Chiller	X	X	X

END OF SECTION 230519

SECTION 230523 – VALVES

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Provide necessary valves within piping systems to provide required flow control and to allow isolation for inspection, maintenance and repair of each piece of equipment or fixture, and on each main and branch service loop.
- B. Valves installed in piping systems shall be compatible with system maximum test pressure, pipe materials, pipe joining method, and fluid or gas conveyed in system.
- C. Valves 2-1/2" and smaller shall have soldered or screwed end connections are required by piping materials unless otherwise specified or shown on drawings. Install union connection in the line within two feet of each screw end valve unless valve can be otherwise easily removed from line. Valves 3" and over shall have flange end connections.
- D. Each valve shall be installed so that it is easily accessible for operation, visual inspection, and maintenance.
- E. Non-rising stem valves shall not be installed at any point in the piping systems. With permission of Contracting Officer non-rising stem valve may be installed at particular points where space is restricted.
- F. Provide 6" and below butterfly valves with latchlock handles for On-Off applications and with Twist-Lock infinite position handle for throttling applications.
- G. Gate valves shall not be installed in pipe lines where intended for throttling service or where piping is subject to vibration as part of normal operating conditions.
- H. Equivalent valves listed on current comparison charts of specified valve manufacturers by Apollo, Crane, Nibco, Dyna Quip, Keystone, Milwaukee, Griswold, or Homestead are acceptable.

PART 2 – PRODUCTS

2.1 BALL VALVES

- A. Ball valves shall be scheduled as type "BLV" valves. Valve specifications by type number shall be as follows:

<u>TYPE NO.</u>	<u>SPECIFICATION</u>
BLV-1	2-1/2" valves and smaller, Appolo #70-100,200 bronze full port ball valve 150PSI-SWP, 600 PSI-WOG, teflon seats, chrome plated ball, blowout proof stem, silicon bronze stem, 1-1/4" extensions or NIB seal, insulated handle where on chilled water, screwedor solder ends.

2.2 BALANCING VALVES

- A. Balancing valves shall be scheduled as Type "BAV" valves. All balancing valves may be installed on the return or supply side of coils and shall be line sized. Provide proper sized valves for the specified flows. Provide strainers at all valves. Valve specification by type number shall be as follows:

<u>TYPE NO.</u>	<u>SPECIFICATION</u>
BAV-1	3/4" thru 2 1/2": Flow Design Inc. model AC automatic type of forged brass with ball valve, flow cartridge, 400 PSIG at 250°F rating and sweat or screw connections as required.
BAV-2	3" and above: Flow Design Inc. model WS automatic type with ductile iron body with waffer style, flow cartridge and 300 PSIG at 250°F rating.
BAV-3	3/4" thru 2 1/ 2": Armstrong model CBV I or CBV II circuit balance valve, meter connections and built-in check valves, 125 psig at 250 deg. F rating and sweat or screw connections as required.

2.3 CHECK VALVES

- A. Silent check valves shall be scheduled as Type "SCV" valves. Valve specifications by type number shall be as follows:

<u>TYPE NO.</u>	<u>SPECIFICATION</u>
SCV-1	2" valves and smaller Stockham Fig. No. B-310T or B-320T bronze check valve, 125 PSI-WOG, spring, brass stem, teflon disc and seat ring, screwed or solder ends as required.
SCV-2	2-1/2" and larger Muessco #101-DT iron body stainless steel trim check valve 150 PSI-ASA with flanged ends.

2.4 BUTTERFLY VALVES

- A. Butterfly valves shall be scheduled as Type "BFV" valves. Valve specifications by type number shall be as follows:

<u>TYPE</u>	<u>SPECIFICATION</u>
BFV-1	3" thru 6", Nibco #LD-200, 200 PSI ductile iron drilled lug body, lever operator aluminum/bronze disc, type 416 stainless steel stem and EPDM sleeve valve shall be bubble tight and designed for dead end service.

2.5 PLUG VALVES

- A. Plug valves shall be scheduled as type PLV valves. Valve specifications by type number shall be as follow

<u>TYPE</u>	<u>SPECIFICATION</u>
PLV-1	1" valves and smaller Homestead Fig. 601 gas cock, 150 PSI-SWP/200 PSI-WOG, bronze plug washer and nut, screwed ends.
PLV-2	1-1/4" thru 4" valves, Rockwell-Nordstrom Fig. 142, semi-steel lubricated plug valve, 175 PSI-WOG coated plug, two bolt cover, short pattern screwed ends. Provide complete with standard pattern cast handle.

2.6 VALVE SCHEDULE

<u>SYSTEM</u>	<u>SIZE</u>	<u>STOP</u>	<u>CHECK</u>	<u>BALANCE</u>
Domestic Water	1/2"-2-1/2"	BLV-1	SCV-1,2	BAV-3
Domestic Water	3" & Up	BFV-1	SCV-2	--
Condenser Water	Up to 2-1/2"	BLV-1	SCV-1	BAV-1/3*
Condenser Water	3"-6"	BFV-1	--	BAV-2*

*Provide manual balance valves on all branch loops and AHU's. Provide automatic balance valves on unit heaters, VAV boxes and fan coil units.

PART 3 – EXECUTION

3.1 GENERAL

- A. Subcontractor may provide valves and accessories as individual components or as pre-assembled groupings from a single manufacturer. Refer to the details on the drawings for all required accessories.

END OF SECTION 230523.

SECTION 230529 - SUPPORTS, ANCHORS, SLEEVES AND SEALS

PART 1 – GENERAL

1.1 COORDINATION

- A. Provide proper type and size pipe sleeves for installation in concrete or masonry walls or floors. Sleeves are not required for supply and waste piping through wall supporting plumbing fixtures or for cast iron soil pipe passing through concrete slab or grade except where penetrating a membrane waterproof floor. Supervise installation of sleeves to insure proper location and installation.

PART 2 – PRODUCTS

2.1 PIPE SLEEVES AND SEALS

- A. Each sleeve shall be continuous through wall floor or roof and shall be cut flush on each side except where indicated otherwise. Sleeves shall not be installed in structural member except where indicated or approved by Structural Engineer.
- B. Sleeves passing through floors subject to flooding such as toilet rooms, bathrooms, chases, equipment rooms and kitchens shall be cast iron with integral flanges and shall extend 1 inch above finished floor. Size sleeves for and seal space between pipe sleeve with Thunderline Link-Seal.
- C. Provide steel pipe sleeves in bearing walls and masonry walls. Opening in non-bearing walls, floors and ceilings may be 20 gauge galvanized pipe sleeves or openings cut with concrete core drill.
- D. Pipe insulation shall run continuous through pipe sleeves with 1/4" minimum clearance between insulation and pipe sleeve. Provide metal jackets over insulated pipes passing through fire walls, floors and smoke partitions. Jacket shall be 0.018 stainless steel extending 12 inches on either side of barrier and secured to insulation with 3/8" wide band. Seal annular space between jacket and pipe sleeves with Metraflex "MS" where non-fire rated. Provide Metraflex "120" at all fire rated applications.
- E. Provide pipes passing through roof of floor waterproof membranes with J.R. Smith or Zurn Z-195-5 flashing sleeve. Seal pipe to sleeve with oakum and caulk with lead.
- F. Where piping passes through walls serving as supply or exhaust air plenums or chases, seal annular space between pipe and sleeve air tight with Thunderline Link Seals.
- G. Submit for review a sleeve drawing showing all required sleeves for piping.

2.2 PIPE HANGERS AND SUPPORTS

- A. Provide and be responsible for locations of piping hangers, supports and inserts, etc., required for installation of piping under this contract. Design of hangers and supports shall conform to current issue of Manufacturers Standardization Society Specification (MSS) SP-58. Application of hangers and supports shall be according to the current issue of (MSS) SP-69.
- B. Pipe hangers shall be capable of supporting piping in all conditions of operation. They shall allow free expansion and contraction of piping, and prevent excessive stress resulting from transferred weight being induced into pipe or connected equipment. Support horizontal or vertical pipes at locations of least vertical movement.
- C. Where horizontal piping movements are such that hanger rod angularity from vertical is greater than 4 degrees from cold to hot position of pipe, offset hanger, pipe, and structural attachments to that rod is vertical in hot position. Hangers shall not become disengaged by movements of supported pipe.
- D. Provide sufficient hangers to adequately support piping system at specified spacing, at changes in piping direction and at concentrated loads. Hangers shall provide for vertical adjustment to maintain pitch required for proper drainage, and for longitudinal travel due to expansion and contraction of piping. Fasten hangers to building structural members wherever practicable and as approved by Structural Engineer.
- E. Hangers in direct contact with copper pipe or tubing shall be copper plated.
- F. Unless indicated otherwise on drawings support horizontal steel piping as follows:

<u>PIPE SIZE</u>	<u>ROD DIAMETER</u>	<u>MAXIMUM SPACING</u>
Up to 1-1/4"	3/8"	8 Ft.
1-1/2" to 2"	3/8"	10 Ft.
2-1/2" to 3-1/2"	1/2"	12 Ft.
4" and 5"	5/8"	15 Ft.
6"	3/4"	17 Ft.
8" to 12"	7/8"	22 Ft.

G. Unless indicated otherwise on drawings support horizontal copper tubing as follows:

<u>NOM. TUBING SIZE</u>	<u>ROD DIAMETER</u>	<u>MAXIMUM SPACING</u>
Up to 1"	3/8"	6 Ft.
1-1/4" to 1-1/2"	3/8"	8 Ft.
2"	3/8"	9 Ft.
2-1/2"	1/2"	9 Ft.
3" and 4"	1/2"	10 Ft.
5"	5/8"	12 Ft.

H. Support horizontal cast iron soil pipe with one hanger for each joint located close to hub.

I. Support vertical cast iron soil pipe and PVC pipe at every floor and steel and copper tubing at every other floor.

J. Provide continuous threaded hanger rods. No chain, wire, or perforated straps shall be used. Hanger rods shall be subject to tensile loading only, where lateral or axial pipe movement occurs provide suitable linkage to permit swing. Provide pipe support channels with galvanized finish for concealed locations and painted finish for exposed locations. Submit design for multiple pipe supports indicating pipe sizes, service and support detail to Contracting Officer for review prior to fabrication.

K. Provide Grinnell pipe hangers for vertical pipe risers as follows:

<u>PIPE MATERIAL</u>	<u>PIPE SIZE</u>	<u>HANGER FIG. NO.</u>
Copper	1/2" thru 4"	CT-121
Steel	3/4" thru 20"	261

L. Provide Grinnell Fig. 194, 195, or 199 steel wall brackets for piping suspended or supported from walls. Brackets shall be prime coated carbon steel.

M. Mount hangers for insulated piping on outside of pipe insulation sized to allow for full thickness of pipe insulation. Provide Grinnell Fig. 167 insulation protection shields sized so that line compressive load does not exceed one-third of insulation compressive strength. Shield shall be galvanized steel and support lower 180 degrees of pipe insulation on copper tubing.

N. Structural attachments for pipe hangers shall be as follows:

- Concrete Structure: Provide Grinnell Fig. No. 285 concrete insert for loads up to 400 lbs. and Grinnell Fig. 281 wedge type concrete insert for loads up to 1200 lbs.
- Steel Beam Structure: Provide Grinnell Fig. No. 86 malleable iron C-clamp for pipe size 2" and smaller and Grinnell Fig. 229 malleable iron beam clamp for pipe size 2-1/2" and larger.

O. Provide Grinnell pipe hangers for horizontal single pipe runs as follows:

<u>PIPE MATERIALS</u>	<u>PIPE SIZE</u>	<u>CLAMP NO.</u>	<u>ROLLER NO.</u>
Copper	1/2" thru 4"	CT-65	
Steel	3/8" thru 4"	65	
Steel	5" thru 30"	260	

P. Provide Fee and Mason Fig. 600 channel trapeze pipe hangers for horizontal multiple pipe runs with pipe clamps or pipe rollers as follows:

<u>PIPE MATERIALS</u>	<u>PIPE SIZE</u>	<u>CLAMP NO.</u>	<u>ROLLER NO.</u>
Copper	3/8" thru 4"	8600 CP*	8010 CP*
Steel	3/8" thru 6"	8500	8010

*Copper Plated

- Q. Pipe supports for horizontal piping mounted on pipe racks or stanchions shall be Advanced Thermal Systems low friction graphite slide supports or equivalent by Ella or Grinnell. Where racks and supports are not detailed on drawings submit detailed support drawings to Contracting Officer for review prior to fabrication.
- R. Provide Fee and Mason Fig. 404 vibration control hangers at locations where piping vibrations would be transmitted to building structure by conventional hangers. Apply hangers within their load supporting range.
- S. Provide Elcen Fig. 50 pipe saddle with adjuster to support piping from floor. Provide complete with pedestal type floor stand.
- T. Provide necessary structural steel and attachment accessories for installations of pipe hangers and supports. Where heavy piping loads are to be attached to building structure verify structural loading with Contracting Officer prior to installations.
- U. Equivalent hangers and supports by Auto-Grip, Basic Engineer, Elcen, Fee & Mason, Fluorcarbon Company, Unistrut or Super Strut Inc., B-Line.

2.3 EQUIPMENT ANCHORS

- A. Provide floor or foundation mounted equipment such as pumps, boilers, air handling units, etc. with Decatur Engineering Company concrete anchors.
- B. Where equipment anchors cannot be installed during forming of floors or foundations anchor equipment with McCulloch Kwik-Bolt concrete anchors.
- C. Anchors shall be proper type and size recommended by manufacturer for equipment to be anchored.
- D. Equivalent by B-Line.

2.4 CONCRETE INSERTS AND ANCHORS

- A. In new construction where attachment points can be predetermined provide Fee & Mason Fig. 9000 continuous concrete insert of Fig. 186 Universal Steel concrete insert.
- B. In existing construction or new construction where attachment points cannot be located before setting concrete forms provide McCulloch Kwik-bolt or Phillips red head concrete anchors of proper type for attachments.
- C. Equivalent by B-Line.

PART 3 – EXECUTION

3.1 RESPONSIBILITY

- A. Contractor shall take full responsibility for the final selection, installation and integrity of the piping support system.
- B. Coordinate pipe hanger locations to avoid overloading of building structural members. Add additional supports where required.

END OF SECTION 230529

SECTION 230548 - MECHANICAL SOUND AND VIBRATION CONTROL

PART 1 – GENERAL

1.1 SCOPE OF WORK

- A. Furnish and install vibration isolation devices for rotating or reciprocating mechanical equipment and piping systems attached thereto.
- B. Work shall include all material and labor required for installation of the resilient mounting and suspension systems, adjusting each mounting system, and measurement of isolator system performance when so requested by the Contracting Officer. Specific mounting arrangements for each item of mechanical equipment shall be as described herein and as indicated by schedules and details on the drawings.

PART 2 – PRODUCTS

2.1 VIBRATION ISOLATION

- A. All vibration isolation equipment, including steel framing and reinforcing for concrete inertia bases and including steel rail bases, shall be furnished by one of the following manufacturers: Peabody Noise Control, Mason Industries, or Amber Booth. A single manufacturer for all vibration isolation equipment will be required except as specifically approved in writing by the Contracting Officer or by his specific approval of shop drawings.
- B. The Contractor and the vibration isolation manufacturer or his regularly designated and factory authorized representative shall perform the following tasks in addition to the supply and installation of isolation equipment:
 - 1. Obtain from the Contracting Officer the approved manufacturer's name, model number, and other necessary identifying data for each item of mechanical and electrical equipment to be resiliently mounted. Coordinate all resilient mounting systems with the exact equipment to be furnished in regard to physical size, isolator locations, weight, rotating speed, etc. Direct contact and cooperation between the vibration isolation device fabricator and the equipment manufacturer will be required.
 - 2. Obtain all necessary data in regard to piping systems which are to be resiliently supported so that proper isolators can be selected. Select piping system isolators for proper coordination with the physical arrangement of pipe lines and with the physical characteristics of the building.
 - 3. Submit shop drawings as required by other portions of this specification. These drawings shall include specification information as follows:
 - a. Manufacturer's model number for each isolator, the machine or pipeline to which it is to be applied, and the number of isolators to be furnished for each machine or pipeline.
 - b. For steel spring mounts or hangers - free height, deflected height, solid height, isolator loading, and diameter of spring coil.
 - c. For elastomer or glass fiber isolators - free height, deflected height, and isolator loading.
 - d. Dimensional and weight data for concrete inertia bases, steel and rail bases, and details of isolator attachment.
 - 4. Provide on-the-job supervision as required during installation of resiliently mounted equipment and piping to assure that all vibration isolators are installed in strict accordance with normally accepted practices for critical environments.
 - 5. Replace at no extra cost to the Owner any isolators which do not produce the required deflection, are improperly loaded above or below their operating height, or which in any way do not produce the required isolation.
 - 6. Cooperate with all other trades engaged in this project so that the installation of vibration isolation devices will proceed in a manner that is in the best interests of the Owner.
 - 7. Notify the Contracting Officer of any project conditions which affect vibration isolation system installation or performance and which are found to be different from conditions indicated by the drawings or described by the specifications. Should vibration isolation system installation proceed without such notifications any remedial work required to achieve proper isolator performance shall be accomplished by the Contractor at no additional cost to the Owner.

8. Be alert for possible "short-circuiting" of vibration isolation systems by piping supports, electrical connections, temperature control connections, drain lines, building construction, etc., and notify the involved contractor as to these problems or potential problems. Where such situations cannot be easily resolved, notify the Contracting Officer so that preventive or remedial action can take place on a timely basis. Any remedial measures required shall be undertaken by the Contractor responsible at no additional cost to the Owner.

2.2 TYPES

- A. The vibration isolation systems described herein and identified by type letter designations shall be applied to specific classifications of mechanical and electrical equipment as indicated in this specification.

TYPE A ISOLATION

The equipment shall be rigidly mounted on a large reinforced concrete inertia block which has length and width dimensions approximately 20% greater than the supported equipment. The inertia block and equipment shall be supported by steel spring vibration isolators. Brackets for the spring isolators shall be located off the sides of the inertia block with the tops of the springs near the vertical center of gravity of the equipment and inertia block; or if the center of gravity is higher than the top of the inertia block, the tops of the springs shall be at the top of the inertia base. The spring isolators shall rest on curbs or pedestals if necessary. There shall be a 2 inch minimum space between the bottom of the inertia base and the top of the housekeeping pad or floor slab when a housekeeping pad is not indicated on the drawings.

Concrete inertia bases shall be formed by a welded steel channel frame which incorporates prelocated equipment anchor bolts, and minimum 1/2 inch diameter reinforcing bars on minimum 8 inch centers each way welded in place. Concrete shall be standard 150-160 lb./cu. ft. structural concrete. The base thickness shall be determined by the weight requirements but it shall be a minimum of 8% of the longest span between isolators or 6 inches, whichever is greater. For centrifugal and axial fans and centrifugal pumps the inertia base shall have a minimum weight equal to that of the isolated equipment. For reciprocating equipment the inertia base shall have a minimum weight equal to twice the weight of the equipment.

Springs shall be of the free standing unhooused type. Horizontal spring stiffness shall not be less than 0.8 of vertical stiffness. Springs shall be selected for reasonably uniform deflection taking into consideration any difference in machine weight at each supporting point, but deflection of each spring shall not be less than that specified for each classification of mechanical equipment. The spring deflection from the point of rated deflection to the point at which the spring is solid shall not be less than 1/2 of the rated static deflection. The yield point of the steel used in the springs shall be sufficiently great so that the springs may be compressed to shorted turns without danger of spring failure. At least two layers of ribbed waffle pattern neoprene pads or equivalent glass fiber pads shall be installed under the base plate of each spring isolator. Springs shall have leveling bolts and proper means for bolting to the machines. To prevent corrosion, springs for outdoor installation shall be galvanized or otherwise coated as approved by the Contracting Officer.

TYPE C ISOLATION

The equipment shall be rigidly mounted in a steel frame which is sufficiently stiff so that it may be supported on resilient isolators without distortion of the frame or mis-alignment of the equipment. If the equipment has an integral frame which is suitably rigid, then the resilient isolators may be secured directly to the integral equipment frame or base.

Isolators shall be selected on the basis of the required static deflection as scheduled or specified, and as follows:

Required deflection 0.25 to 0.4 inches - double deflection neoprene-in-shear isolators.

Required deflection 0.5 inches and greater - steel spring isolators as specified for the Type A mounting. Isolators shall be selected for reasonably uniform deflection taking into consideration any difference in machine weight at each supporting point, but deflection shall not be less than that specified for each classification of equipment.

Minimum clearance between the equipment base and the housekeeping pad or floor shall be 2 inches.

TYPE D ISOLATION

The equipment shall be suspended with steel spring vibration isolators which are complete with neoprene-in-shear isolators for high frequency noise control. The neoprene-in-shear isolators shall provide static deflection of 0.20 inches minimum. In addition, elastomer washers shall be furnished as necessary to prevent metal-to-metal contact.

Hanger rod misalignment of up to 15 degrees relative to vertical shall not cause "short-circuiting" of the isolation components due to metal-to-metal contact.

Spring hangers shall utilize free standing springs which are unhooused except for the required partial and open housing assembly. Spring hangers shall be selected for reasonably uniform deflection taking into consideration any difference in machine weight at each supporting point, but deflection of each hanger shall not be less than that specified for each classification of mechanical equipment. The spring deflection from the point of rated deflection to the point at which the spring is solid shall not be less than one-half of the rated static deflection. The yield point of the steel used in the springs shall be sufficiently great so that the springs may be compressed to shorted turns without danger of spring failure.

Resilient hangers shall be installed as near as possible to the supporting overhead structure. The machine suspension points shall be in a rigid and heavy portion of the building structure. Suspension of machines from lightweight floor slabs shall be avoided, particularly at the center of structural spans.

Suspension rods shall be attached to rigid members of the machine structure. When such attachment points do not exist, a heavy steel framework shall be furnished to support the machine with suspension rods attached to this framework.

B. Schedule

Equipment	Power HP or as Noted	Rotating Speed RPM	Mounting Type	Inertia Base*	Static Deflection**
Pumps	All	1750	D	-	1.5"
Floor mounted AHU's	1 - 50	500 and Up	C	-	0.75
Suspended AHU's, fan coils, and other Suspended Equipment	0 - 7-1/2	500 and Up	D	-	0.75"

*Minimum inertia base weight expressed as multiple of weight of supported equipment.

**Minimum static deflection of isolators specified for mounting type indicated.

2.3 DUCT WRAP

- A. Refer to the drawings for locations where ductwork is to receive acoustical wrapping. Completely wrap duct in areas shown and provide proper support for both duct and wrap. Wrap shall be DB Engineering #B-10 LAG/QFA-9 at approximately 1.4 lbs/SF, 2" thickness and STC of 30.

PART 3 – EXECUTION

3.1 ISOLATION OF PIPING SYSTEMS

- A. All piping which connects to resiliently mounted equipment shall be suspended with resilient hangers or supported by floor mounted isolators for a distance of 100 pipe diameters from the connected machine or within the mechanical equipment room whichever is the greater distance. The first three supports from the connected machine shall have the same static deflection as indicated for the machine; the next two supports shall have static deflection at least equal to one-half of the static deflection indicated for the machine mounting, and remaining pipe supports shall provide static deflection of 0.35 inches minimum. These remaining isolators may be elastomer.
- B. Steel spring hangers shall be as specified for Type D isolation except that a scale shall be attached to the hanger housing to indicate deflection.
- C. Vertical pipe risers shall be resiliently mounted, preferably with each riser anchored near the center of the run. The risers shall be supported at the anchor points with steel spring or double deflection neoprene-in-shear isolators which provide static deflection of at least 0.35 inches. Isolators for the remainder of each run shall be steel spring type specifically designed to control load shifting due to pipe expansion and contraction. At least 0.35 inches deflection shall be maintained under all conditions.
- D. Drain connections from isolated equipment to floor drains shall be at least 1" free from drain or use rubber hose.

3.2 ISOLATION OF FRACTIONAL HORSEPOWER EQUIPMENT

- A. All fractional horsepower fans, pumps, etc., which are mounted on or suspended from floors that are on-grade shall be isolated with neoprene-in-shear isolators furnished by the vibration isolation supplier except where such isolators are furnished as an integral part of the machine.

3.3 MANUFACTURERS FOR VIBRATION ISOLATION DEVICES

- A. Amber-Booth Company, Mason Industries, Peabody Noise Control (Kinetics), Vibration Eliminator.

END OF SECTION 230548.

SECTION 230553 - TESTING & BALANCING MECHANICAL SYSTEMS & DUCTWORK

PART 1 - GENERAL (REFERENCE SECTION 230500)

1.1 TESTING AND BALANCING

- A. Testing and balancing of the building air and hydronic systems will be to be completed near the end of construction. The Subcontractor has responsibility to cooperate with, make adjustments for, and provide any equipment necessary for the TAB agency to complete the job. Include all testing and balancing costs in subcontractor's bid.

1.2 ACCEPTABLE TESTING AND BALANCING FIRMS:

Energy Management & Control Corporation
3639 SW Summerfield Drive, Suite B
Topeka, KS 66614
(785) 233-0289

Allied Labs
303 S. Topeka
Wichita, KS 67202
(316) 262-6457

Doyle Field Services, Inc.
646 W. 58th St.
Kansas City, MO 64113
(816) 444-7103

ViroCon
1627 Main St. Suite 600
Kansas City, MO 64108
(816) 842-9225

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION

3.1 SYSTEM PREPARATION FOR TESTING AND BALANCING

- A. Prior to requesting testing and balancing agency to perform their work the installing Subcontractor shall make all necessary inspections and adjustments to insure that systems are completely installed and operating in accordance with the manufacturer's recommendations and the contract documents.
- B. The following checks shall be performed on each system installed under this contract. A report sheet shall be prepared by the testing and balancing firm for each system indicating checks made, corrective action taken where required, date, and name of person making inspection. Submit two copies of the checklist to the A/E.

1. Air Handling Systems:

- a. Clear system of all foreign objects & clean system.
- b. Verify fan rotation.
- c. Check bearing condition and lubrication.
- d. Check fan wheel clearances & fan alignment.
- e. Check motor security to mounting base.
- f. Check alignment of drive.
- g. Check vibration isolator adjustment.
- h. Verify that proper filter media is installed.
- i. Verify that all control dampers are installed and operable without binding or sticking.
- j. Confirm that all fire, smoke and volume dampers are installed and in full open position.
- k. Verify that all air terminal units are installed.
- l. Confirm that all air openings in walls above ceilings have been provided.
- m. Check for and repair all excessive air leaks in duct systems, at equipment connections and at coils. Air leaks shall not exceed SMACNA parameters for system pressure.

- n. Verify that ductwork is constructed and installed in accordance with contract drawings and/or approved ductwork shop drawings.
2. Hydronic Systems:
 - a. Confirm pump shaft alignment, grouting and fastening of pump base.
 - b. Verify that all pump vibration isolators are properly adjusted and that flexible connections are properly restrained and aligned.
 - c. Check pump bearing for proper lubrication and condition.
 - d. Verify pump rotation and impeller size.
 - e. Confirm that total system has been hydrostatically tested, flushed, filled, vented and water treated as required.
 - f. Confirm that all strainer baskets are in place, clean and are the proper type.
 - g. Verify that all pressure reducing and control valves are operating properly.
 - h. Confirm that all expansion tanks are installed and contain proper air charge.
 - i. Verify that access to all balancing valves and flow stations in walls and ceilings have been provided.
 - j. Inspect and clean all coils and correct fin damage.
 - k. Confirm that fittings have been provided for flow and temperature measurements at all coils, heat exchangers and pumps.
 - l. Verify that all piping connections to 3-way valves and coils are proper for flow direction as indicated by manufacturer and temperature control Subcontractor.
 3. Boiler & Cooling Tower:
 - a. Verify cleaning and start-up was in accordance with manufacturers recommendations. Submit start-up log with report.
 - b. Verify that flow switches and pump interlocks are installed and operating properly.
 - c. Inspect and adjust all vibration isolation devices and flexible piping connections for alignment and restraint.
- C. Temperature Controls Contractor (TCC) Balancer Coordination
1. First Day: The TCC shall have a technical representative present with the Balancer on the first day of balancing for a minimum of 4 hours of active balancing – temperature controls coordination.
 2. Remainder of Balancing: The TCC shall either:
 - Have a technical representative continuously present at each step of the continuation of the balancing OR
 - Furnish the Balancer with the latest DDC software any required interface device for the duration of the balancing process. This option includes instructing the Balancer in the use of the software until the Balancer is proficient in the use of the software. Software and interface device shall be returned to TCC when balance report has been accepted. There shall be no charge to the owner or the to the Balancer for the use of the software, OR
 - Furnish the Balancer with the latest DDC software and any required interface device, and a portable computer for the duration of the balancing process. This option includes instructing the Balancer in the use of the portable computer and the software until the Balancer is proficient in the use of the software. Portable computer, interface device, and software shall be returned to the TCC when balance report has been accepted. There shall be no charge to the Owner or to the Balancer for the use of the software or portable computer.

3.2 COORDINATION & RESPONSIBILITIES

- A. Attend initial Commissioning Orientation Meeting scheduled by the Commissioning Agent and all other construction meetings as necessary.
- B. Submit the draft and final TAB procedures and all proposed test forms to the Commissioning Agent and design professional for review and acceptance.
- C. Attend the TAB Process Meeting scheduled by the Commissioning Agent. Be prepared to discuss the procedures that shall be followed in testing, adjusting and balancing the HVAC system.

- D. Notify the Commissioning Agent a minimum of (2) two weeks in advance of the time for start of the TAB work.
- E. Begin TAB work only after Pre-Functional Procedures, leak testing, start-up, etc. have been completed, documented, reviewed and approved.
- F. Work with the Controls Contractor to assist in properly calibrating the controls system.
- G. Provide Commissioning Agent with copies of in-progress, hand-written reports of TAB work, when requested on a regular basis.

3.3 AIR AND WATER BALANCE

- A. The Subcontractor shall procure the services of the independent air balance and testing agency, approved by the Contracting Officer, which specializes in the balancing and testing of heating, ventilating and air conditioning systems, to balance, adjust, and test air moving equipment and air distribution and exhaust systems and all water flow circuits. All work by this agency shall be done under direct supervision of a qualified heating and ventilating Contracting Officer employed by them. All instruments used by this agency shall be accurately calibrated within six months of performing work and maintained in good working order. If requested the tests shall be conducted in the presence of the Contracting Officer responsible for the project and/or its representative. The testing and balancing firm shall be certified by NEBB or AABC and all work shall be performed in accordance with these organizations' published procedure manuals.
- B. Air balance and testing shall not begin until systems have been completed and are in full working order. All heating, ventilation, and air conditioning systems and equipment shall be in full operation during each working day of testing and balancing.
- C. The Subcontractor shall make changes in pulleys, belts, dampers, etc., as required by the test and balance agency, at no additional cost to the Owner.
- D. The Subcontractor shall install new filters in the air handlers and clean all strainers in the water system just prior to the beginning of the testing and balancing.
- E. The control manufacturer or its representative shall assist the test and balance agency in setting automatic dampers, valves, etc., as required.
- F. The balancing agency shall prepare a certified report of all tests performed. The report shall be written on standard forms prepared by NEBB or AABC or facsimiles thereof. The balancing agency shall submit 3 copies of this report to the Subcontractor who shall submit them to the A/E for review and distribution.
- G. The air and waterflows shall be balanced to within $\pm 10\%$ of design requirements.

END OF SECTION 230553

SECTION 230700 - PIPING AND EQUIPMENT INSULATION

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

- A. Provide necessary materials and accessories for installation of insulation for mechanical systems as specified and/or detailed on drawings. Insulation type and thickness for specific piping systems or equipment shall be as listed in insulation schedule.
- B. Provide insulation materials manufactured by Armacell, Certain/Teed Saint Gobain, Dow Chemical, Johns-Manville or Owen-Corning.
- C. Insulation, except where specified otherwise, shall have composite fire and smoke hazard ratings as rested by ASTM E-84, NFPA 255, and UL 723 procedures not exceeding:

FLAME SPREAD	25
SMOKE DEVELOPED	50
FUEL CONTRIBUTED	50

Provide insulation accessories such as adhesives, mastics, cements, tape with same component ratings as listed above. Products or their shipping cartons shall bear label indicating their flame and smoke safety shall be permanent. Use of water soluble treatments such as corn paste or wheat paste is not acceptable. This does not exclude approved lagging adhesives.

- D. Install insulation over clean dry surfaces with joints firmly butted together. Insulation at equipment, flanges, fittings, etc. shall have straight edges with box type joints with corner beads at corners. Total insulation system shall have neat smooth appearance with no wrinkles, or folds in jackets, joint strips or fitting covers.
- E. Undamaged insulation systems on cold surface piping and equipment shall perform their intended functions as vapor barriers and thermal insulation without premature deterioration of insulation or vapor barrier. Take every reasonable precaution to provide insulation systems with continuous unbroken vapor barriers.
- F. Insulation failing to meet workmanship and appearance standards shall be replaced with an acceptable installation before final acceptance of project will be given. Insulation failing to meet performance requirements of this specification for a period of one year after date of final acceptance or through one heating season and one cooling season, whichever is longer shall be replaced with an acceptable installation. All costs to correct insulation deficiencies and costs to repair damages to other work shall be at Contractor's expense at no cost to Owner.

1.2 SUBMITTALS

- A. Provide submittals for pipe insulation used on this project as specified in Section 01010.

PART 2 – PRODUCTS

2.1 INSULATION MATERIALS AND APPLICATION METHODS

- A. Pipe insulation by type shall be as follows:

Type 1-PHC: Insulation For Hot And Cold Surface Piping systems with -70 degrees F to +450 degrees F operating range shall be Owens-Corning Fiberglass 25, 4.0 lb. density pipe insulation with white fire retardant ASJ jacket. Average thermal conductivity shall not exceed .26 BTU/Hr. at 75 degrees F mean temperature. Seal longitudinal jacket laps and butt strips with C.M. No. 17-465 or B.F. No. 85-75 vapor barrier adhesive. Insulate valves and fittings as follows: Insulate exposed and concealed valves and fittings with 2" thick glass fiberglass inserts or blankets. Cover fittings with Zeston Products PVC fitting covers or approved equal. PVC fitting covers shall be secured with mechanical fasteners such as tacks or staples for temperatures above 75 degrees F. For cold service all joints shall be sealed with vapor barrier adhesive or by pressure sensitive vapor barrier vinyl tape.

Type 1-PC: Insulation for cold surface equipment insulation for external surfaces with minus 70°F to 220°F operating temperature range shall be Armacell pipe insulation. Average thermal conductivity shall not exceed 0.27 BTU/HR at 75°F mean temperature. Apply insulation directly to metal surfaces and seal insulation joints with Armstrong No. 520. Insulation shall be mitered, beveled and built-up as required to provide a smooth and neat exterior surface. Finish insulation with two coats of Armacell "WB Armaflex" finish.

2.2 PIPE INSULATION SCHEDULE

<u>SYSTEM</u>	<u>SIZE</u>	<u>TYPE</u>	<u>THICKNESS</u>
Dom. Water Above Grade	Up to 2"	1-PHC	1/2"
Dom. Water Above Grade	2 1/2" & above	1-PHC	1"
Dom. Water Below Grade	All	1-PC	1"
Condenser Water	Up to 1 1/4"	1-PHC	1"
Condenser Water	1 1/2" & Up	1-PHC	1 1/2"
Roof Drain	All	1-PHC	1"
Refrigerant Suction	All	1-PC*	1/2"
Condensate Drains	All	1-PC	1/2"
Expansion Tanks	All	1-PC	1/2"
Air Separators	All	1-PC	1/2"

* Provide continuous aluminum jacketing over pipe insulation outdoors.
 Note: Hot water system valves need not be insulated.

PART 3 - EXECUTION

3.1 PIPE SUPPORTS

- A. Insulate hanger and supports from direct contact with cold or hot surfaces (-120 deg. F to 450 deg.) with "Buckaroos Inc." or approved equal pipe insulation support system. The wood dowel adhered to a PVC disc shall be installed as follows:
 - 1. Up thru 2-1/2" pipe: One "Buckaroo" placed exactly at the hanger location.
 - 2. 3" thru 5-1/2" pipe: Three "Buckaroos" placed in the lower 180 degree arc of the pipe exactly at the hanger location.
 - 3. 6" pipe and above: Nine "Buckaroos" strategically placed similar to the 3" thru 5-1/2" pipe sizes and within the length of the hanger protection saddle.
- B. The length of the "Buckaroo" insulation support same as the pipe insulation thickness. Provide ASJ type discs to reestablish vapor barrier.
- C. The insulation support system shall be installed in combination with the hanger saddles.
- D. Hanger saddle shall be "Buckaroo Inc." or approved equal, with an outward flared edge.
- E. Piping hanger cannot be isolated from cold pipe surfaces. Insulate piping at hanger locations with extra thickness of pipe insulation. Insulate hanger rod to point 12" above pipe with minimum insulation thickness equal to one-half thickness of pipe insulation. Seal and finish joints with vapor barrier sealer for insulation type used.

3.2 LAVATORIES/SINKS TRIM

- A. Insulate all exposed supplies and traps/tailpieces with Truebro "Handi Lav-Guard" insulation kit 102. Equal by Brocar Products.

END OF SECTION 230700

SECTION 230701 - DUCTWORK INSULATION

PART 1 – GENERAL

1.1 SUBMITTALS

- A. Provide submittals for ductwork insulation used on this project as specified in Section 01010.

1.2 INSULATION

- A. Provide necessary materials and accessories for installation of interior and exterior ductwork insulation as specified and/or detailed on drawings. Insulation type and thickness for specific ductwork systems shall be as listed in insulation schedule in this section of specification.

PART 2 – PRODUCTS

2.1 DUCTWORK INSULATION

- A. Provide insulation materials manufactured by Armstrong Cork Co., Certain-Teed/Saint Gobin, Johns-Manville or Owens-Corning.
- B. Insulation and application adhesives, except where specified otherwise, shall have fire and smoke hazard rating as tested by ASTM E-84 procedure not exceeding:

FLAME SPREAD	25
SMOKE DEVELOPED	50
FUEL CONTRIBUTED	50

Insulation shall meet ASTM C411 performance test and shall be installed in conformance with NFPA Standard 90A.

- C. Abbreviations for manufacturers of adhesives, insulating cements and coatings specified shall be C.M. for Chicago Mastic Company, B.F. for Benjamin Foster Company and 3M for 3M Company. Average thermal conductivity is expressed in BTU/Hr/Sq.Ft./ degrees F/In.
- D. Install interior duct liner insulation cut to insure tight fitting corners and longitudinal joints. Apply liner to sheet metal with 100% coverage of C.M. No. 176-477, B.F. No. 81-19 or 3M No. 36 adhesive applied in accordance with manufacturers recommended applications rate. Coat all edges of liner with adhesive. Provide mechanical fasteners on surfaces 18" or wider in addition to liner adhesive with fastener clips set flush with duct liner surface. Provide fasteners as follows:
1. Low Velocity Ductwork (Velocities less than 2000 FPM): Provide fasteners within 3" of leading edge of each section 12" O.C. around joint perimeter and 3" from longitudinal joints 12" O.C. Elsewhere space fasteners 18" O.C. except not more than 6" from longitudinal joints 9 not 12" from corner break.
 2. High Velocity Ductwork (Velocities 2000 to 6000 FPM): Provide fasteners within 3" of leading edge of each section 6" O.C. around joint perimeter and 3" from longitudinal joints 6" O.C. Elsewhere space fasteners 16" O.C. except not more than 6" from longitudinal joints nor 12" from corner break. Provide liner upstream leading edges on ducts with velocities 4000 FPM and greater with metal nosing or channels. The above fastener spacing and nosing are minimum requirements. Where liner manufacturer recommends nosing at lower velocities close fastener spacing or fasteners on smaller ducts. Provide fasteners in accordance with their recommendations.
- E. Provide round sheet metal ductwork with exterior thermal insulation of type and thickness listed in insulation schedule. Apply insulation with joints tightly butted together with longitudinal and end joint strips sealed with vapor barrier adhesive. Insulate fittings with insulation thickness equal to adjoining insulation with cover overlapping 2" onto adjacent covering.
- F. Duct insulation materials by type shall be as follows:
1. Type 1-DIL: Internal acoustical and thermal duct insulation for all ductwork shall be 3 lb. density 1" thick duct liner with minimum NRC of 0.70 and 0.23 BTUH thermal conductivity at 75 degrees mean temperature. Absorption coefficient @ 250 Hz shall be a minimum of 0.25. The airstream surface shall be treated with an EPA registered antimicrobial agent. Product shall be Certainteed "ToughGard2", Equivalent by Owens Corning.

2. Type 2-DEW: External thermal insulation for low, medium and high pressure round duct shall be Certaineed "Soft Touch" 100 with foil-scrim-kraft facing and .26 BTUH thermal conductivity at 75 degrees mean temperature.

PART 3 – EXECUTION

3.1 SCHEDULE

- A. Specific lining materials and installation methods for ductwork systems shall be as follows:

<u>DUCTWORK SYSTEM</u>	<u>DUCT LINING TYPE</u>	<u>THICKNESS</u>
Rectangular Supply	2-DEW	1-1/2"
Round Ductwork	2-DEW	1-1/2"
Outside Air Intakes	2-DEW	1-1/2"
Relief & Return Transfer	2-DEW	1-1/2"
Air Boots	2-DEW	1-1/2"
Rectangular Return	2-DEW	1-1/2"
Make-up Air	2-DEW	1-1/2"
Exhaust Ductwork	2-DEW	1/2"

END OF SECTION 230701

SECTION 230900 - FACILITY MANAGEMENT SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-23 Basic Mechanical Materials and Methods sections apply to work of this section.

1.2 DESCRIPTION OF WORK

- A. General: The control system shall consist of a high-speed, peer-to-peer network of DDC controllers and a web-based operator interface. Depict each mechanical system and building floor plan by a point-and-click graphic. A web server with a network interface card shall gather data from this system and generate web pages accessible through a conventional web browser on each PC connected to the network. Operators shall be able to perform all normal operator functions through the web browser interface.
- B. The system shall directly control HVAC equipment as specified. Each zone controller shall provide occupied and unoccupied modes of operation by individual zone. Furnish energy conservation features such as optimal start and stop, night setback, request-based logic, and demand level adjustment of setpoints as specified in Appendix A.
- C. Provide for future system expansion to include monitoring of occupant card access, fire alarm, and lighting control systems.
- D. System shall use the BACnet protocol for communication to the operator workstation or web server and for communication between control modules. Schedules, setpoints, trends, and alarms shall be BACnet objects.

1.3 QUALITY ASSURANCE

- A. Installer shall have an established working relationship with Control System Manufacturer.
- B. Installer shall have successfully completed Control System Manufacturer's control system training. Upon request, Installer shall present record of completed training including course outlines.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data for each control device furnished, indicating dimensions, capacities, performance and electrical characteristics, and material finishes, also include installation and start-up instructions.
- B. Shop Drawings: submit shop drawings for each DDC control system, containing the following information:
 - 1. Schematic flow diagram of system showing fans, pumps, coils, dampers, valves, and control devices.
 - 2. Indicate all required electrical wiring. clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
 - 3. Include verbal description of sequence of operation. The sequence of operation shall be detailed enough for the maintenance personnel to be able to troubleshoot the system.

1.5 WORK BY OTHERS

- A. Sheet Metal Subcontractor:
 - 1. Setting of automatic control dampers, duct-mounted airflow stations, and necessary blank off plates.
 - 2. Access doors where and as required.
- B. Piping Contractor:
 - 1. Installation of immersion wells and pressure taps.
 - 2. Installation of flow switches.
 - 3. Setting of automatic control valves.

4. Installation of pressure taps and associated shut-off cocks.
- C. Electrical Contractor:
1. All power wiring and line voltage interlock wiring such as exhaust fan interlocked to supply fan or other control wiring shown specifically on the electrical plans.
- D. HVAC Supplier (as applicable):
1. The HVAC supplier shall provide a 24VAC transformer for the operation of the heat pump DDC thermostat and heat pump controls.
- E. Electrical Work for Controls:
1. All electrical work for automatic controls, except as otherwise specified, or shown on the electrical drawings shall be included in this Division.
 2. Electrical work shall, in general, comply with the following:
 - a. All low voltage wiring in finished rooms shall be concealed below working heights and exposed above.
 - b. Electrical work may include both line voltage and low voltage wiring, as required for the control system. Any control wiring not specifically shown on the electrical plans shall be provided by the FMS contractor. Low voltage wiring may be run open using plenum-rated cables in concealed accessible locations.
 - c. Conduit network for power systems shall be used for running control high voltage wiring.
 - d. All safety devices shall be wired through both hand and auto positions of motor starting device to insure 100% safety shut-off.
- F. Guarantee
1. All components, parts and assemblies shall be guaranteed against defects in material and workmanship for a period of one year after acceptance.
- G. System Performance
1. Performance Standards. System shall conform to the following minimum standards over network connections. Systems shall be tested using manufacturer's recommended hardware and software for operator workstation (server and browser for web-based systems).
 2. Graphic Display. A graphic with 20 dynamic points shall display with current data within 10 sec.
 3. Graphic Refresh. A graphic with 20 dynamic points shall update with current data within 8 sec. and shall automatically refresh every 15 sec.
 4. Configuration and Tuning Screens. Screens used for configuring, calibrating, or tuning points, PID loops, and similar control logic shall automatically refresh within 6 sec.
 5. Object Command. Devices shall react to command of a binary object within 2 sec. Devices shall begin reacting to command of an analog object within 2 sec.
 6. Alarm Response Time. An object that goes into alarm shall be annunciated at the workstation within 15 sec.
 7. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 sec. Select execution times consistent with the mechanical process under control.
 8. Performance. Programmable controllers shall be able to completely execute DDC PID control loops at a frequency adjustable down to once per sec. Select execution times consistent with the mechanical process under control.
 9. Multiple Alarm Annunciation. Each workstation on the network shall receive alarms within 5 sec of other workstations.
- 1.6 WARRANTY
- A. Warrant work as follows:
1. Warrant labor and materials for specified control system free from defects for a period of 12 months after final acceptance. Control system failures during warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner. Respond during normal business hours within 24 hours of Owner's warranty service request.
 2. Work shall have a single warranty date, even if Owner receives beneficial use due to early system start-up. If specified work is split into multiple contracts or a multi-phase contract, each contract or phase shall have a separate warranty start date and period.

3. If Contracting Officer determines that equipment and systems operate satisfactorily at the end of final start-up, testing, and commissioning phase, Contracting Officer will certify in writing that control system operation has been tested and accepted in accordance with the terms of this specification. Date of acceptance shall begin warranty period.
4. Provide updates to operator workstation or web server software, project-specific software, graphic software, database software, and firmware that resolve Contractor-identified software deficiencies at no charge during warranty period. If available, Owner can purchase in-warranty service agreement to receive upgrades for functional enhancements associated with above-mentioned items. Do not install updates or upgrades without Owner's written authorization.
5. Exception: Contractor shall not be required to warrant reused devices except those that have been rebuilt or repaired. Installation labor and materials shall be warranted. Demonstrate operable condition of reused devices at time of Contracting Officer's acceptance.

1.7 OWNERSHIP OF PROPRIETARY MATERIAL

- A. Project-specific software and documentation shall become Owner's property. This includes, but is not limited to:
 1. Graphics
 2. Record drawings
 3. Database
 4. Application programming code
 5. Documentation

PART 2 – PRODUCTS

2.1 Materials

- A. Use new products the manufacturer is currently manufacturing and selling for use in new installations. Do not use this installation as a product test site unless explicitly approved in writing by Owner. Spare parts shall be available for at least five years after completion of this contract.

2.2 Communication

- A. Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a BACnet internetwork. Controller and operator interface communication shall conform to ASHRAE/ANSI Standard 135-2001, BACnet. The DDC system will be certified and accredited (C&A) to AF ETL 11-1 cyber requirements. The system requirements will include but not be limited to:
 1. Role based accounts
 2. Secure information stored encrypted
 3. Screen secured with predetermined level of inactivity
 4. Non-repudiation capable
- B. Install new wiring and network devices as required to provide a complete and workable control network. Use existing Ethernet backbone for network segments marked "existing" on project drawings. Project drawings indicate remote buildings or sites to be connected by a nominal 56,000 baud modem over voice-grade telephone lines. In each remote location a modem and field device connection shall allow communication with each controller on the internetwork as specified in Paragraph D.
- C. Each controller shall have a communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations.
- D. Internetwork operator interface and value passing shall be transparent to internetwork architecture.
 1. An operator interface connected to a controller shall allow the operator to interface with each internetwork controller as if directly connected. Controller information such as data,

status, and control algorithms shall be viewable and editable from each internetwork controller.

2. Inputs, outputs, and control variables used to integrate control strategies across multiple controllers shall be readable by each controller on the internetwork. Program and test all cross-controller links required to execute control strategies specified in Section 230900 Appendix A. An authorized operator shall be able to edit cross-controller links by typing a standard object address or by using a point-and-click interface.
- E. Controllers with real-time clocks shall use the BACnet Time Synchronization service. System shall automatically synchronize system clocks daily from an operator-designated controller via the internetwork. If applicable, system shall automatically adjust for daylight saving and standard time.
- F. System shall be expandable to at least twice the required input and output objects with additional controllers, associated devices, and wiring.

2.3 Operator Interface

- A. Operator Interface. Web server shall reside on high-speed network with building controllers. Each standard browser connected to server shall be able to access all system information. In addition to the primary operator interface, the system shall include a secondary interface compatible with a locally available commercial wireless network and viewable on a commercially available wireless device such as a Wireless Access Protocol (WAP) enabled cellular telephone or personal digital assistant (PDA). This secondary interface may be text-based and shall provide a summary of the most important data. As a minimum, the following capabilities shall be provided through this interface:
1. An operator authentication system that requires an operator to log in before viewing or editing any data, and which can be configured to limit the privileges of an individual operator.
 2. The ability to view and acknowledge any alarm in the system. Alarms or links to alarms shall be provided on a contiguous list so the operator can quickly view all alarms.
 3. A summary page or pages for each piece of equipment in the system. This page shall include the current values of all critical I/O points and shall allow the operator to lock binary points on or off and to lock analog points to any value within their range.
 4. Navigation links that allow the operator to quickly navigate from the home screen to any piece of equipment in the system, and then return to the home screen. These links may be arranged in a hierarchical fashion, such as navigating from the home screen to a particular building, then to a specific floor in the building, and then to a specific room or piece of equipment.
- B. Communication. Web server or workstation and controllers shall communicate using BACnet protocol. Web server or workstation and control network backbone shall communicate using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing as specified in ASHRAE/ANSI 135-2001, BACnet Annex J.
- C. Hardware. Each workstation or web server shall consist of the following:
1. Hardware Base. Industry-standard hardware shall meet or exceed DDC system manufacturer's recommended specifications and shall meet response times specified in Section 230900 Paragraph 1.9. Hard disk shall have sufficient memory to store system software, one year of data for trended points specified in Appendix A, and a system database at least twice the size of the existing database at system acceptance. Configure computers and network connections if multiple computers are required to meet specified memory and performance. Upgrade existing system computer if required. Web server or workstations shall be IBM-compatible PCs with a minimum of:
 - a. Intel Pentium 2.66 GHz processor

- b. 1 GB RAM
 - c. 40 GB hard disk providing data at 100 MB/sec
 - d. 48x CD-ROM drive
 - e. Serial, parallel, and network communication ports and cables required for proper system operation
 2. Modem. Auto-dial modem and associated cables shall transmit over voice-grade telephone lines at a nominal 56,000 baud and shall provide communication between workstation or web server and remote buildings and workstations.
- D. Operator Functions. Operator interface shall allow each authorized operator to execute the following functions as a minimum:
 1. Log In and Log Out. System shall require user name and password to log in to operator interface.
 2. Point-and-click Navigation. Operator interface shall be graphically based and shall allow operators to access graphics for equipment and geographic areas using point-and-click navigation.
 3. View and Adjust Equipment Properties. Operators shall be able to view controlled equipment status and to adjust operating parameters such as setpoints, PID gains, on and off controls, and sensor calibration.
 4. View and Adjust Operating Schedules. Operators shall be able to view scheduled operating hours of each schedulable piece of equipment on a weekly or monthly calendar-based graphical schedule display, to select and adjust each schedule and time period, and to simultaneously schedule related equipment. System shall clearly show exception schedules and holidays on the schedule display.
 5. View and Respond to Alarms. Operators shall be able to view a list of currently active system alarms, to acknowledge each alarm, and to clear (delete) unneeded alarms.
 6. View and Configure Trends. Operators shall be able to view a trend graph of each trended point and to edit graph configuration to display a specific time period or data range. Operator shall be able to create custom trend graphs to display on the same page data from multiple trended points.
 7. View and Configure Reports. Operators shall be able to run preconfigured reports, to view report results, and to customize report configuration to show data of interest.
 8. Manage Control System Hardware. Operators shall be able to view controller status, to restart (reboot) each controller, and to download new control software to each controller.
 9. Manage Operator Access. Typically, only a few operators are authorized to manage operator access. Authorized operators shall be able to view a list of operators with system access and of functions they can perform while logged in. Operators shall be able to add operators, to delete operators, and to edit operator function authorization. Operator shall be able to authorize each operator function separately.
- E. System Software.
 1. Operating System. Web server shall have an industry-standard professional-grade operating system. Acceptable systems include Microsoft Windows XP Pro, Red Hat Linux, or Sun Solaris.
 2. System Graphics. Operator interface shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone, graphics for each chilled water and hot water system, and graphics that summarize conditions on each floor of each building included in this contract. Indicate thermal comfort on floor plan summary graphics using dynamic colors to represent zone temperature relative to zone setpoint.
 - a. Functionality. Graphics shall allow operator to monitor system status, to view a summary of the most important data for each controlled zone or piece of

- equipment, to use point-and-click navigation between zones or equipment, and to edit setpoints and other specified parameters.
- b. Animation. Graphics shall be able to animate by displaying different image files for changed object status.
 - c. Alarm Indication. Indicate areas or equipment in an alarm condition using color or other visual indicator.
 - d. Format. Graphics shall be saved in an industry-standard format such as BMP, JPEG, or GIF. Web-based system graphics shall be viewable on browsers compatible with World Wide Web Consortium browser standards. Web graphic format shall require no plug-in (such as HTML and JavaScript) or shall only require widely available no-cost plug-ins (such as Active-X and Macromedia Flash).
- F. System Tools. System shall provide the following functionality to authorized operators as an integral part of the operator interface or as stand-alone software programs. If furnished as part of the interface, the tool shall be available from each workstation or web browser interface. If furnished as a stand-alone program, software shall be installable on standard IBM-compatible PCs with no limit on the number of copies that can be installed under the system license.
1. Automatic System Database Configuration. Each workstation or web server shall store on its hard disk a copy of the current system database, including controller firmware and software. Stored database shall be automatically updated with each system configuration or controller firmware or software change.
 2. Controller Memory Download. Operators shall be able to download memory from the system database to each controller.
 3. System Configuration. Operators shall be able to configure the system.
 4. Online Help. Context-sensitive online help for each tool shall assist operators in operating and editing the system.
 5. Security. System shall require a user name and password to view, edit, add, or delete data.
 - a. Operator Access. Each user name and password combination shall define accessible viewing, editing, adding, and deleting functions in each system application, editor, and object. Authorized operators shall be able to vary and deny each operator's accessible functions based on equipment or geographic location.
 - b. Automatic Log Out. Automatically log out each operator if no keyboard or mouse activity is detected. Operators shall be able to adjust automatic log out delay.
 - c. Encrypted Security Data. Store system security data including operator passwords in an encrypted format. System shall not display operator passwords.
 6. System Diagnostics. System shall automatically monitor controller and I/O point operation. System shall annunciate controller failure and I/O point locking (manual overriding to a fixed value).
 7. Alarm Processing. System input and status objects shall be configurable to alarm on departing from and on returning to normal state. Operator shall be able to enable or disable each alarm and to configure alarm limits, alarm limit differentials, alarm states, and alarm reactions for each system object. Configure and enable alarm points as specified in Section 230900 Appendix A (Sequences of Operation). Alarms shall be BACnet alarm objects and shall use BACnet alarm services.
 8. Alarm Messages. Alarm messages shall use an English language descriptor without acronyms or mnemonics to describe alarm source, location, and nature.
 9. Alarm Reactions. Operator shall be able to configure (by object) actions workstation or web server shall initiate on receipt of each alarm. As a minimum, workstation or web server shall be able to log, print, start programs, display messages, send e-mail, send page, and audibly annunciate.
 10. Alarm Maintenance. Operators shall be able to view system alarms and changes of state chronologically, to acknowledge and delete alarms, and to archive closed alarms to the workstation or web server hard disk from each workstation or web browser interface.

11. Trend Configuration. Operator shall be able to configure trend sample or change of value (COV) interval, start time, and stop time for each system data object and shall be able to retrieve data for use in spreadsheets and standard database programs. Controller shall sample and store trend data and shall be able to archive data to the hard disk. Configure trends as specified in Section 230900 Appendix A (Sequences of Operation). Trends shall be BACnet trend objects.
12. Object and Property Status and Control. Operator shall be able to view, and to edit if applicable, the status of each system object and property by menu, on graphics, or through custom programs.
13. Reports and Logs. Operator shall be able to select, to modify, to create, and to print reports and logs. Operator shall be able to store report data in a format accessible by standard spreadsheet and word processing programs.
14. Standard Reports. Furnish the following standard system reports:
 - a. Objects. System objects and current values filtered by object type, by status (in alarm, locked, normal), by equipment, by geographic location, or by combination of filter criteria.
 - b. Alarm Summary. Current alarms and closed alarms. System shall retain closed alarms for an adjustable period.
 - c. Logs. System shall log the following to a database or text file and shall retain data for an adjustable period:
 - i. Alarm History.
 - ii. Trend Data. Operator shall be able to select trends to be logged.
 - iii. Operator Activity. At a minimum, system shall log operator log in and log out, control parameter changes, schedule changes, and alarm acknowledgment and deletion. System shall date and time stamp logged activity.
15. Custom Reports. Operator shall be able to create custom reports that retrieve data, including archived trend data, from the system, that analyze data using common algebraic calculations, and that present results in tabular or graphical format. Reports shall be launched from the operator interface.
16. Graphics Generation. Graphically based tools and documentation shall allow Operator to edit system graphics, to create graphics, and to integrate graphics into the system. Operator shall be able to add analog and binary values, dynamic text, static text, and animation files to a background graphic using a mouse.
17. Graphics Library. Complete library of standard HVAC equipment graphics shall include equipment such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. Library shall include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. Library graphic file format shall be compatible with graphics generation tools.
18. Custom Application Programming. Operator shall be able to create, edit, debug, and download custom programs. System shall be fully operable while custom programs are edited, compiled, and downloaded. Programming language shall have the following features:
 - a. Language. Language shall be graphically based or English language oriented. If graphically based, language shall use function blocks arranged in a logic diagram that clearly shows control logic flow. Function blocks shall directly provide functions listed below, and operators shall be able to create custom or compound function blocks. If English language oriented, language shall be based on the syntax of BASIC, FORTRAN, C, or PASCAL, and shall allow for free-form programming that is not column-oriented or "fill-in-the-blanks."
 - b. Programming Environment. Tool shall provide a full-screen, cursor-and-mouse-driven programming environment that incorporates word processing features such as cut and paste. Operators shall be able to insert, add, modify, and delete custom programming code, and to copy blocks of code to a file library for reuse in other control programs.

- c. Independent Program Modules. Operator shall be able to develop independently executing program modules that can disable, enable and exchange data with other program modules.
 - d. Debugging and Simulation. Operator shall be able to step through the program observing intermediate values and results. Operator shall be able to adjust input variables to simulate actual operating conditions. Operator shall be able to adjust each step's time increment to observe operation of delays, integrators, and other time-sensitive control logic. Debugger shall provide error messages for syntax and for execution errors.
 - e. Conditional Statements. Operator shall be able to program conditional logic using compound Boolean (AND, OR, and NOT) and relational (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
 - f. Mathematical Functions. Language shall support floating-point addition, subtraction, multiplication, division, and square root operations, as well as absolute value calculation and programmatic selection of minimum and maximum values from a list of values.
 - g. Variables: Operator shall be able to use variable values in program conditional statements and mathematical functions.
 - i. Time Variables. Operator shall be able to use predefined variables to represent time of day, day of the week, month of the year, and date. Other predefined variables or simple control logic shall provide elapsed time in seconds, minutes, hours, and days. Operator shall be able to start, stop, and reset elapsed time variables using the program language.
 - ii. System Variables. Operator shall be able to use predefined variables to represent status and results of Controller Software and shall be able to enable, disable, and change setpoints of Controller Software as described in Controller Software section.
- G. Portable Operator's Terminal. Provide all necessary software to configure an IBM-compatible laptop computer for use as a Portable Operator's Terminal. Operator shall be able to connect configured Terminal to the system network or directly to each controller for programming, setting up, and troubleshooting.
- H. BACnet. Web server or workstation shall have demonstrated interoperability during at least one BMA Interoperability Workshop and shall substantially conform to BACnet Operator Workstation (B-OWS) device profile as specified in ASHRAE/ANSI 135-2001, BACnet Annex L.

2.4 Controller Software

- A. Building and energy management application software shall reside and operate in system controllers. Applications shall be editable through operator workstation, web browser interface, or engineering workstation.
- B. System Security. See Paragraph 2.3.F.5 (Security) and Paragraph 2.3.F.15.c (Operator Activity).
- C. Scheduling. See Paragraph 2.3.D.4 (View and Adjust Operating Schedules). System shall provide the following schedule options as a minimum:
 - 1. Weekly. Provide separate schedules for each day of the week. Each schedule shall be able to include up to 5 occupied periods (5 start-stop pairs or 10 events).
 - 2. Exception. Operator shall be able to designate an exception schedule for each of the next 365 days. After an exception schedule has executed, system shall discard and replace exception schedule with standard schedule for that day of the week.
 - 3. Holiday. Operator shall be able to define 24 special or holiday schedules of varying length on a scheduling calendar that repeats each year.
- D. System Coordination. Operator shall be able to group related equipment based on function and location and to use these groups for scheduling and other applications.

- E. Binary and Analog Alarms. See Paragraph 2.3.F.7 (Alarm Processing).
- F. Alarm Reporting. See Paragraph 2.3.F.9 (Alarm Reactions).
- G. Remote Communication. System shall automatically contact operator workstation or server on receipt of critical alarms. If no network connection is available, system shall use a modem connection.
- H. Demand Limiting.
 - 1. System shall monitor building power consumption from building power meter pulse generator signals or from building feeder line watt transducer or current transformer.
 - 2. When power consumption exceeds adjustable levels, system shall automatically adjust setpoints, de-energize low-priority equipment, and take other programmatic actions to reduce demand as specified in Section 230900 Appendix A (Sequences of Operation). When demand drops below adjustable levels, system shall restore loads as specified.
- I. Maintenance Management. System shall generate maintenance alarms when equipment exceeds adjustable runtime, equipment starts, or performance limits. Configure and enable maintenance alarms as specified in Section 230900 Appendix A (Sequences of Operation).
- J. Sequencing. Application software shall sequence chillers, boilers, and pumps as specified in Section 230900 Appendix A (Sequences of Operation).
- K. PID Control. System shall provide direct- and reverse-acting PID (proportional-integral-derivative) algorithms. Each algorithm shall have anti-windup and selectable controlled variable, setpoint, and PID gains. Each algorithm shall calculate a time-varying analog value that can be used to position an output or to stage a series of outputs.
- L. Staggered Start. System shall stagger controlled equipment restart after power outage. Operator shall be able to adjust equipment restart order and time delay between equipment restarts.
- M. Energy Calculations.
 - 1. System shall accumulate and convert instantaneous power (kW) or flow rates (L/s [gpm]) to energy usage data.
 - 2. System shall calculate a sliding-window average (rolling average). Operator shall be able to adjust window interval to 15 minutes, 30 minutes, or 60 minutes.
- N. Anti-Short Cycling. Binary output objects shall be protected from short cycling by means of adjustable minimum on-time and off-time settings.
- O. On and Off Control with Differential. System shall provide direct- and reverse-acting on and off algorithms with adjustable differential to cycle a binary output based on a controlled variable and setpoint.
- P. Runtime Totalization. System shall provide an algorithm that can totalize runtime for each binary input and output. Operator shall be able to enable runtime alarm based on exceeded adjustable runtime limit. Configure and enable runtime totalization and alarms as specified in Section 230900 Appendix A (Sequence of Operations).

2.5 Controllers

- A. General. Provide Building Controllers (BC), Advanced Application Controllers (AAC), Application Specific Controllers (ASC), Smart Actuators (SA), and Smart Sensors (SS) as required to achieve performance specified in Section 230900 Article 1.9 (System Performance). Every device in the system which executes control logic and directly controls HVAC equipment must conform to a standard BACnet Device profile as specified in ASHRAE/ANSI 135-2001, BACnet Annex L. Unless otherwise specified, hardwired actuators and sensors may be used in lieu of BACnet Smart Actuators and Smart Sensors.
- B. BACnet.
1. Building Controllers (BCs). Each BC shall conform to BACnet Building Controller (B-BC) device profile as specified in ASHRAE/ANSI 135-2001, BACnet Annex L and shall be listed as a certified B-BC in the BACnet Testing Laboratories (BTL) Product Listing.
 2. Advanced Application Controllers (AACs). Each AAC shall conform to BACnet Advanced Application Controller (B-AAC) device profile as specified in ASHRAE/ANSI 135-2001, BACnet Annex L and shall be listed as a certified B-AAC in the BACnet Testing Laboratories (BTL) Product Listing.
 3. Application Specific Controllers (ASCs). Each ASC shall conform to BACnet Application Specific Controller (B-ASC) device profile as specified in ASHRAE/ANSI 135-2001, BACnet Annex L and shall be listed as a certified B-ASC in the BACnet Testing Laboratories (BTL) Product Listing.
 4. Smart Actuators (SAs). Each SA shall conform to BACnet Smart Actuator (B-SA) device profile as specified in ASHRAE/ANSI 135-2001, BACnet Annex L and shall be listed as a certified B-SA in the BACnet Testing Laboratories (BTL) Product Listing.
 5. Smart Sensors (SSs). Each SS shall conform to BACnet Smart Sensor (B-SS) device profile as specified in ASHRAE/ANSI 135-2001, BACnet Annex L and shall be listed as a certified B-SS in the BACnet Testing Laboratories (BTL) Product Listing.
 6. BACnet Communication.
 - a. Each BC shall reside on or be connected to a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing.
 - b. BACnet routing shall be performed by BCs or other BACnet device routers as necessary to connect BCs to networks of AACs and ASCs.
 - c. Each AAC and ASC shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
 - d. Each SA shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
 - e. Each SS shall reside on a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol with BACnet/IP addressing, or it shall reside on a BACnet network using ARCNET or MS/TP Data Link/Physical layer protocol.
- C. Communication.
1. Service Port. Each controller shall provide a service communication port for connection to a Portable Operator's Terminal. Connection shall be extended to space temperature sensor ports where shown on drawings.
 2. Signal Management. BC and ASC operating systems shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and to allow for central monitoring and alarms.
 3. Data Sharing. Each BC and AAC shall share data as required with each networked BC and AAC.
 4. Stand-Alone Operation. Each piece of equipment specified in Section 230900 Appendix A shall be controlled by a single controller to provide stand-alone control in the event of communication failure. All I/O points specified for a piece of equipment shall be integral to its controller. Provide stable and reliable stand-alone control using default values or other method for values normally read over the network.

- D. Environment. Controller hardware shall be suitable for anticipated ambient conditions.
 - 1. Controllers used outdoors or in wet ambient conditions shall be mounted in waterproof enclosures and shall be rated for operation at -29°C to 60°C (-20°F to 140°F).
 - 2. Controllers used in conditioned space shall be mounted in dust-protective enclosures and shall be rated for operation at 0°C to 50°C (32°F to 120°F).
- E. Keypad. Provide a local keypad and display for each BC and AAC. Operator shall be able to use keypad to view and edit data. Keypad and display shall require password to prevent unauthorized use. If the manufacturer does not normally provide a keypad and display for each BC and AAC, provide the software and any interface cabling needed to use a laptop computer as a Portable Operator's Terminal for the system.
- F. Real-Time Clock. Controllers that perform scheduling shall have a real-time clock.
- G. Serviceability.
 - 1. Controllers shall have diagnostic LEDs for power, communication, and processor.
 - 2. Wires shall be connected to a field-removable modular terminal strip or to a termination card connected by a ribbon cable.
 - 3. Each BC and AAC shall continually check its processor and memory circuit status and shall generate an alarm on abnormal operation. System shall continuously check controller network and generate alarm for each controller that fails to respond.
- H. Memory.
 - 1. Controller memory shall support operating system, database, and programming requirements.
 - 2. Each BC and AAC shall retain BIOS and application programming for at least 72 hours in the event of power loss.
 - 3. Each ASC and SA shall use nonvolatile memory and shall retain BIOS and application programming in the event of power loss. System shall automatically download dynamic control parameters following power loss.
- I. Immunity to Power and Noise. Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).
- J. Transformer. ASC power supply shall be fused or current limiting and shall be rated at a minimum of 125% of ASC power consumption.

2.6 Input and Output Interface

- A. General. Hard-wire input and output points to BCs, AACs, ASCs, or SAs.
- B. Protection. Shorting an input or output point to itself, to another point, or to ground shall cause no controller damage. Input or output point contact with up to 24 V for any duration shall cause no controller damage.
- C. Binary Inputs. Binary inputs shall monitor the on and off signal from a remote device. Binary inputs shall provide a wetting current of at least 12 mA and shall be protected against contact bounce and noise. Binary inputs shall sense dry contact closure without application of power external to the controller.

- D. Pulse Accumulation Inputs. Pulse accumulation inputs shall conform to binary input requirements and shall accumulate up to 10 pulses per second.
- E. Analog Inputs. Analog inputs shall monitor low-voltage (0-10 Vdc), current (4-20 mA), or resistance (thermistor or RTD) signals. Analog inputs shall be compatible with and field configurable to commonly available sensing devices.
- F. Binary Outputs. Binary outputs shall send an on-or-off signal for on and off control. Building Controller binary outputs shall have three-position (on-off-auto) override switches and status lights. Outputs shall be selectable for normally open or normally closed operation.
- G. Analog Outputs. Analog outputs shall send a modulating 0-10 Vdc or 4-20 mA signal as required to properly control output devices. Each Building Controller analog output shall have a two-position (auto-manual) switch, a manually adjustable potentiometer, and status lights. Analog outputs shall not drift more than 0.4% of range annually.
- H. Tri-State Outputs. Control three-point floating electronic actuators without feedback with tri-state outputs (two coordinated binary outputs). Tri-State outputs may be used to provide analog output control in zone control and terminal unit control applications such as VAV terminal units, duct-mounted heating coils, and zone dampers.
- I. Universal Inputs and Outputs. Inputs and outputs that can be designated as either binary or analog in software shall conform to the provisions of this section that are appropriate for their designated use.

2.7 Power Supplies And Line Filtering

- A. Power Supplies. Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.
 - 1. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100-microsecond response time for 50% load changes. Unit shall have built-in over-voltage and over-current protection and shall be able to withstand 150% current overload for at least three seconds without trip-out or failure.
 - a. Unit shall operate between 0°C and 50°C (32°F and 120°F). EM/RF shall meet FCC Class B and VDE 0871 for Class B and MILSTD 810C for shock and vibration.
 - b. Line voltage units shall be UL recognized and CSA listed.
- B. Power Line Filtering.
 - 1. Provide internal or external transient voltage and surge suppression for workstations and controllers. Surge protection shall have:
 - a. Dielectric strength of 1000 V minimum
 - b. Response time of 10 nanoseconds or less
 - c. Transverse mode noise attenuation of 65 dB or greater
 - d. Common mode noise attenuation of 150 dB or greater at 40-100 Hz

2.8 Auxiliary Control Devices

A. Motorized Control Dampers.

1. Type. Control dampers shall have linear flow characteristics and shall be parallel- or opposed-blade type as specified below or as scheduled on drawings.
 - a. Outdoor and return air mixing dampers and face-and-bypass dampers shall be parallel-blade and shall direct airstreams toward each other.
 - b. Other modulating dampers shall be opposed-blade.
 - c. Two-position shutoff dampers shall be parallel- or opposed-blade with blade and side seals.
2. Frame. Damper frames shall be 2.38 mm (13 gauge) galvanized steel channel or 3.175 mm (1/8 in.) extruded aluminum with reinforced corner bracing.
3. Blades. Damper blades shall not exceed 20 cm (8 in.) in width or 125 cm (48 in.) in length. Blades shall be suitable for medium velocity (10 m/s [2000 fpm]) performance. Blades shall be not less than 1.5875 mm (16 gauge).
4. Shaft Bearings. Damper shaft bearings shall be as recommended by manufacturer for application, oil impregnated sintered bronze, or better.
5. Seals. Blade edges and frame top and bottom shall have replaceable seals of butyl rubber or neoprene. Side seals shall be spring-loaded stainless steel. Blade seals shall leak no more than $50 \text{ L/s}\cdot\text{m}^2$ (10 cfm per ft^2) at 1000 Pa (4 in. w.g.) differential pressure. Blades shall be airfoil type suitable for wide-open face velocity of 7.5 m/s (1500 fpm).
6. Sections. Damper sections shall not exceed 125 cm - 150 cm (48 in. - 60 in.). Each section shall have at least one damper actuator.
7. Linkages. Dampers shall have exposed linkages.

B. Electric Damper and Valve Actuators.

1. Stall Protection. Mechanical or electronic stall protection shall prevent actuator damage throughout the actuator's rotation.
2. Spring-return Mechanism. Actuators used for power-failure and safety applications shall have an internal mechanical spring-return mechanism or an uninterruptible power supply (UPS).
3. Signal and Range. Proportional actuators shall accept a 0-10 Vdc or a 0-20 mA control signal and shall have a 2-10 Vdc or 4-20 mA operating range. (Floating motor actuators may be substituted for proportional actuators in terminal unit applications as described in paragraph 2.6H.)
4. Wiring. 24 Vac and 24 Vdc actuators shall operate on Class 2 wiring.
5. Manual Positioning. Operators shall be able to manually position each actuator when the actuator is not powered. Non-spring-return actuators shall have an external manual gear release. Spring-return actuators with more than 7 N·m (60 in.-lb) torque capacity shall have a manual crank.

C. Control Valves.

1. General. Select body and trim materials in accordance with manufacturer's recommendations for design conditions and service shown.
2. Type. Provide two- or three-way control valves for two-position or modulating service as shown.
3. Water Valves.
 - a. Valves providing two-position service shall be quick opening. Two-way valves shall have replaceable disc or ball.
 - b. Close-off (Differential) Pressure Rating. Valve actuator and trim shall provide the following minimum close-off pressure ratings.
 - i. Two-way: 150% of total system (pump) head.

- ii. Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.
 - c. Ports. Valves providing modulating service shall have equal percentage ports.
 - d. Sizing.
 - i. Two-position service: line size.
 - ii. Two-way modulating service: select pressure drop equal to the greatest of twice the pressure drop through heat exchanger (load), 50% of the pressure difference between supply and return mains, or 35 kPa (5 psi).
 - iii. Three-way modulating service: select pressure drop equal to the smaller of twice the pressure drop through the coil exchanger (load) or 35 kPa (5 psi).
 - e. Fail Position. Water valves shall fail normally open or closed as follows unless otherwise specified.
 - i. Water zone valves: normally open.
 - ii. Heating coils in air handlers: normally open.
 - iii. Chilled water control valves: normally closed.
 - iv. Other applications: as scheduled or as required by sequences of operation.
- 4. Steam Valves.
 - a. Close-off (Differential) Pressure Rating. Valve actuator and trim shall provide minimum close-off pressure rating equal to 150% of operating (inlet) pressure.
 - b. Ports. Valves providing modulating service shall have linear ports.
 - c. Sizing.
 - i. Two-position service: select pressure drop equal to 10%-20% of inlet psig.
 - ii. Modulating service at 100 kPa (15 psig) or less: select pressure drop equal to 80% of inlet psig.
 - iii. Modulating service at 101-350 kPa (16-50 psig): select pressure drop equal to 50% of inlet psig.
 - iv. Modulating service at over 350 kPa (50 psig): select pressure drop as scheduled on drawings.

D. Binary Temperature Devices.

1. Low-Voltage Space Thermostats. Low-voltage space thermostats shall be 24 V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed setpoint adjustment, 13°C-30°C (55°F-85°F) setpoint range, 1°C (2°F) maximum differential, and vented ABS plastic cover.
2. Line-Voltage Space Thermostats. Line-voltage space thermostats shall be bimetal-actuated, open-contact type or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listing for electrical rating, concealed setpoint adjustment, 13°C-30°C (55°F-85°F) setpoint range, 1°C (2°F) maximum differential, and vented ABS plastic cover.
3. Low-Limit Thermostats. Low-limit airstream thermostats shall be UL listed, vapor pressure type. Element shall be at least 6 m (20 ft) long. Element shall sense temperature in each 30 cm (1 ft) section and shall respond to lowest sensed temperature. Low-limit thermostat shall be manual reset only.

E. Temperature Sensors.

1. Type. Temperature sensors shall be Resistance Temperature Device (RTD) or thermistor.
2. Duct Sensors. Duct sensors shall be single point or averaging as shown. Averaging sensors shall be a minimum of 1.5 m (5 ft) in length per 1 m² (10 ft²) of duct cross-section.
3. Immersion Sensors. Provide immersion sensors with a separable stainless steel well. Well pressure rating shall be consistent with system pressure it will be immersed in. Well shall withstand pipe design flow velocities.

4. Space Sensors. Space sensors shall have setpoint adjustment, override switch, display, and communication port as shown.
5. Differential Sensors. Provide matched sensors for differential temperature measurement.

F. Humidity Sensors.

1. Duct and room sensors shall have a sensing range of 20%-80%.
2. Duct sensors shall have a sampling chamber.
3. Outdoor air humidity sensors shall have a sensing range of 20%-95% RH and shall be suitable for ambient conditions of 40°C-75°C (40°F-170°F).
4. Humidity sensors shall not drift more than 1% of full scale annually.

G. Flow Switches. Flow-proving switches shall be paddle (water service only) or differential pressure type (air or water service) as shown. Switches shall be UL listed, SPDT snap-acting, and pilot duty rated (125 VA minimum).

1. Paddle switches shall have adjustable sensitivity and NEMA 1 enclosure unless otherwise specified.
2. Differential pressure switches shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.

H. Relays.

1. Control Relays. Control relays shall be plug-in type, UL listed, and shall have dust cover and LED "energized" indicator. Contact rating, configuration, and coil voltage shall be suitable for application.
2. Time Delay Relays. Time delay relays shall be solid-state plug-in type, UL listed, and shall have adjustable time delay. Delay shall be adjustable $\pm 100\%$ from setpoint shown. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure for relays not installed in local control panel.

I. Override Timers.

1. Unless implemented in control software, override timers shall be spring-wound line voltage, UL Listed, with contact rating and configuration required by application. Provide 0-6 hour calibrated dial unless otherwise specified. Flush mount timer on local control panel face or where shown.

J. Current Transmitters.

1. AC current transmitters shall be self-powered, combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4-20 mA two-wire output. Full-scale unit ranges shall be 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A, with internal zero and span adjustment. Unit accuracy shall be $\pm 1\%$ full-scale at 500 ohm maximum burden.
2. Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized.
3. Unit shall be split-core type for clamp-on installation on existing wiring.

K. Current Transformers.

1. AC current transformers shall be UL/CSA recognized and shall be completely encased (except for terminals) in approved plastic material.
2. Transformers shall be available in various current ratios and shall be selected for $\pm 1\%$ accuracy at 5 A full-scale output.
3. Use fixed-core transformers for new wiring installation and split-core transformers for existing wiring installation.

L. Voltage Transmitters.

1. AC voltage transmitters shall be self-powered single-loop (two-wire) type, 4-20 mA output with zero and span adjustment.
2. Adjustable full-scale unit ranges shall be 100-130 Vac, 200-250 Vac, 250-330 Vac, and 400-600 Vac. Unit accuracy shall be $\pm 1\%$ full-scale at 500 ohm maximum burden.
3. Transmitters shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized at 600 Vac rating.

M. Voltage Transformers.

1. AC voltage transformers shall be UL/CSA recognized, 600 Vac rated, and shall have built-in fuse protection.
2. Transformers shall be suitable for ambient temperatures of 4°C-55°C (40°F-130°F) and shall provide $\pm 0.5\%$ accuracy at 24 Vac and 5 VA load.
3. Windings (except for terminals) shall be completely enclosed with metal or plastic.

N. Power Monitors.

1. Power monitors shall be three-phase type and shall have three-phase disconnect and shorting switch assembly, UL listed voltage transformers, and UL listed split-core current transformers.
2. Power monitors shall provide selectable output: rate pulse for kWh reading or 4-20 mA for kW reading. Power monitors shall operate with 5 A current inputs and maximum error of $\pm 2\%$ at 1.0 power factor or $\pm 2.5\%$ at 0.5 power factor.

O. Current Switches.

1. Current-operated switches shall be self-powered, solid-state with adjustable trip current. Select switches to match application current and DDC system output requirements.

P. Pressure Transducers.

1. Transducers shall have linear output signal and field-adjustable zero and span.
2. Continuous operating conditions of positive or negative pressure 50% greater than calibrated span shall not damage transducer sensing elements.
3. Water pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Transducer shall have 4-20 mA output, suitable mounting provisions, and block and bleed valves.
4. Water differential pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Over-range limit (differential pressure) and maximum static pressure shall be 2000 kPa (300 psi.) Transducer shall have 4-20 mA output, suitable mounting provisions, and 5-valve manifold.

Q. Differential Pressure Switches. Differential pressure switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum) and shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.

R. Pressure-Electric (PE) Switches. PE switches shall be UL listed, pilot duty rated (125 VA minimum) or motor control rated, metal or neoprene diaphragm actuated, operating pressure rated for 0-175 kPa (0-25 psig), with calibrated scale minimum setpoint range of 14-125 kPa (2-18 psig).

1. Provide one- or two-stage switch action (SPDT, DPST, or DPDT) as required by application.
2. Switches shall be open type (panel-mounted). Exception: Switches shall be enclosed type for remote installation. Enclosed type shall be NEMA 1 unless otherwise specified.
3. Each pneumatic signal line to PE switches shall have permanent indicating gauge.

S. Local Control Panels.

1. Indoor control panels shall be fully enclosed NEMA 1 construction with hinged door key-lock latch and removable sub-panels. A common key shall open each control panel and sub-panel.
2. Prewire internal and face-mounted device connections with color-coded stranded conductors tie-wrapped or neatly installed in plastic troughs. Field connection terminals shall be UL listed for 600 V service, individually identified per control and interlock drawings, with adequate clearance for field wiring.
3. Each local panel shall have a control power source power switch (on-off) with overcurrent protection.

2.9 Wiring And Raceways

- A. General. Provide copper wiring, plenum cable, and raceways as specified in applicable sections of Division 16.
- B. Insulated wire shall use copper conductors and shall be UL listed for 90°C (200°F) minimum service.

2.10 Fiber Optic Cable System

- A. Optical Cable. Optical cables shall be duplex 900 mm tight-buffer construction designed for intra-building environments. Sheath shall be UL listed OFNP in accordance with NEC Article 770. Optical fiber shall meet the requirements of FDDI, ANSI X3T9.5 PMD for 62.5/125mm.
- B. Connectors. Field terminate optical fibers with ST type connectors. Connectors shall have ceramic ferrules and metal bayonet latching bodies.

PART 3 – EXECUTION

3.1 INSTALLATION OF ELECTRIC CONTROL SYSTEMS

- A. General: Install systems and materials in accordance with manufacturer's instructions and roughing-in drawings, and details on drawings. I
- B. Control Wiring: The term "control wiring" is defined to include providing of wire, conduit and miscellaneous materials as required for mounting and connecting electric control devices.
- C. Wiring System: Install complete control wiring system for electric control systems. Conceal wiring except in mechanical rooms and areas where other conduit and piping are exposed. All control wiring in mechanical and electrical spaces that are exposed shall be installed in EMT conduit. Low voltage control wiring that is located in concealed, accessible areas may be plenum-rated cable.
- D. Reset Limit Controls: Install manual-reset limit controls to be independent of power controllers; automatic duct heater resets may, at Contractor's option, be installed in interlock circuit of power controllers.
- E. For all space temperature sensors, the FMS contractor shall mount all sensors on a standard wallbox mounted flush to the wall being attached. The wallbox shall have 1/2" EMT conduit extending from the wallbox to the area above the ceiling for pulling of sensor wiring.

3.2 START-UP AND VERIFICATION

- A. Start-Up: Start-up, test, and adjust electric control systems in presence of manufacturer's authorized representative. Demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
- B. Verification: After completion of installation, adjust thermostats, control valves, motors and similar equipment provided as work of this section.

3.3 GRAPHIC GENERATION

- A. Graphics shall be generated on the existing server for all systems as outlined in this spec and shown on the plans.

3.4 CLOSEOUT PROCEDURES

- A. Inspection and Approval

- 1. Upon successful completion of System generation, the Owner's authorized representative shall be requested in writing to inspect and approve the satisfactory operation of the System, subsystem(s), and accessories. Upon receipt of the detailed system adjustment list from the Owner's authorized representative, an installation inspection report shall be prepared by the Facility Management System Contractor showing by system each outstanding item on the system adjustments list.

3.5 OPERATOR INSTRUCTIONS

- A. During system commissioning and at such time acceptable performance of the System hardware and software has been established, the FMS Contractor shall provide 1 week of on-site operator instruction to the owner's operating personnel. Operator instruction during normal working hours shall be performed by a competent FMS Contractor representative familiar with the System's software, hardware and accessories.
- B. Additional instruction time as deemed necessary by the Owner's authorized representative may be obtained from the Building Automation Contractor on a negotiated basis by the Owner.

END OF SECTION 230900

SECTION 232113 - PIPING AND FITTINGS

PART 1 – GENERAL

1.1 SUBMITTALS

- A. Provide submittals for piping used on this project as specified in Section 013300.

PART 2 – PRODUCTS

2.1 PIPING MATERIALS AND FITTINGS

- A. Piping used throughout project shall conform to the following specifications. Piping shall be plainly marked with manufacturers name and weight. Piping materials shall be as follows:

1. Cast Iron Bell and Spigot Soil Pipe:
 - a. Pipe and fittings shall be gray cast iron bell and spigot ends with lead grooves and spigot end lead beads. Pipe and fittings shall be coated inside and out with asphaltum preservative and meet requirements of current Cast Iron Soil Pipe Institute Standard HS-67 and ASTM Standard A74-94.
 - b. Seal joints with lead and oakum in accordance with current ANSI Specification A40.8.
 - c. (Optional) Seal joints with neoprene pipe gaskets meeting current ASTM Standard A564-68.
 - d. Pipe and fittings by Tyler Pipe or Charlotte. AB & I
2. Hubless Cast Iron Soil Pipe:
 - a. Pipe and fittings may be gray cast iron with spigot bead and positioning lug. Pipe and fittings shall be coated inside and out with asphaltum preservative and shall meet requirements of current Cast Iron Pipe Institute Standard 301-95, ASTMA888.
 - b. Pipe joints shall be no-hub joint couplings consisting of neoprene rubber sleeve, stainless steel shield and clamp assembly. CISPI 310-95.
 - c. (Optional) Pipe joints shall be MB coupling consisting of cast iron housing with neoprene gasket and 18-8 stainless steel bolts and nuts.
 - d. Pipe and fittings shall be by Tyler Pipe or Charlotte.
3. Carbon Steel Pipe (1/8" thru 2"):
 - a. Provide seamless carbon steel conforming to ASTM specification A-106 scheduled.
 - b. Pipe joints shall be threaded conforming to ANSI Standard B2.1.
 - c. Pipe ends shall be beveled for welding.
 - d. Pipe by Armco, Jones and Laughlin Steel Corp., Youngstown Sheet and Tube Co., or United States Steel.
4. Carbon Steel Pipe (2-1/2" and above):
 - a. Provide furnace butt-welded carbon steel pipe conforming to ASTM Specification A-53.
 - b. Pipe ends shall be beveled for welding.
 - c. Pipe by Armco, Jones and Laughlin Steel Corp., Youngstown Sheet and Tube Co., or United States Steel.
5. Copper Tube:
 - a. Provide hard temper copper water tube conforming to requirements of current ASTM Specification B-88. Tubing shall be Type K, L, or M as listed in schedule.
 - b. Tubing joints shall be soldered or brazed. See schedule for joining method to be used.
 - c. Pipe by Anaconda, Cerro, Chase, Mueller or Revere Copper.
6. Copper Tube Type ACR:
 - a. Provide hard temper nitrogenized copper refrigerant tube conforming to requirements of current ASTM B-88. Tubes shall be type L or K as listed in schedule.
 - b. Tubing joints shall be brazed.
 - c. Pipe by Anaconda, Cerro, or Mueller.

7. Plastic Soil Pipe
 - a. Below grade/exterior pipe and fittings shall be ABS solid wall pipe extra strength conforming to SDR-23.5 & ASTM-D-275-69.
 - b. Below slab pipe and fittings shall be PVC-DWV conforming to ASTM-D-2665.
8. Below Grade Pipe
 - a. Perma-Pipe "Quick-Therm", or equal, with HDPE service piping, rigid polyurethane insulation, HDPE jacket and thermal butt fusion welded joints.

2.2 PIPING FITTINGS

- A. Piping fitting used throughout project shall be proper type for installation method used and shall be compatible with piping system material. Fittings listed in piping material schedule shall conform to the following specifications:
 1. Malleable Iron Screwed Fittings:
 - a. Provide screwed malleable iron fittings conforming to ANSI Standard B16.3, and ASTM Specification A-47 grade 32510.
 - b. Fittings by Crane, Grinnell or Stockham.
 2. Cast Iron Screwed Fittings:
 - a. Provide screwed cast iron fittings conforming to ANSI Standard B16.4, B2.1, and ASTM Specification A-126, Class A.
 - b. Fittings by Crane, Grinnell or Stockham.
 3. Wrought Copper Fittings:
 - a. Provide wrought solder joint copper tube fitting conforming to ANSI Standard B16.22
 - b. Fittings by Anaconda, Chase or Nibco.
 4. Cast Bronze Fittings:
 - a. Provide cast bronze solder joint fittings conforming to ANSI Standard B16.18.
 - b. Fittings by Anaconda, Chase or Nibco.
 5. Pipe Flange Gaskets:
 - a. Provide 1/16" thick synthetic gaskets full face or ring type as required. Gaskets shall be factory cut.
 - b. Gaskets by John Crane Co. Mfg. Co., Garlock Company, or Raybestos Manhattan.
- B. T-drill fittings are not acceptable on this project.

PART 3 – EXECUTION

3.1 PIPING INSTALLATION

- A. Piping systems materials and installation shall conform with the following standards and codes.
 1. System: Heating and Air Conditioning Piping
Code: ANSI Standard B31.1.0 "Power Piping"
 2. System: Natural Gas Piping
Code: ANSI Standard B31.12 "Fuel Gas Piping"
 3. System: Plumbing System Piping
Code: International Assoc. of Plumbing & Mechanical Official's "International Plumbing Code"
- B. Pipe sizes indicated on Drawings and as specified refer to nominal size in inches for steel pipe, cast iron pipe and copper tubing, unless otherwise indicated. Pipes are sized to nearest 1/2". In no case shall piping smaller than size specified be used.

- C. Contractor shall provide and be responsible for proper location of pipe sleeves, hangers, supports, and inserts. Install hangers, supports, inserts, etc., as recommended by manufacturer or as specified and detailed on drawings. Verify construction types and provide proper hangers, inserts and supports for construction used. Install inserts, hangers and supports in accordance with manufacturers load ratings and provide for thermal expansion of piping without exceeding allowable stress on piping or supports. Provide copper plated hangers and supports for suspension of insulated copper tubing lines.
- D. Install piping parallel with building lines and parallel with other piping to obtain a neat and orderly appearance of piping system. Secure piping with approved anchors and provide guides where necessary to insure proper direction of piping expansion. Piping shall be installed so that allowable stress for piping, valves and fittings used are not exceeded during normal operation or testing of piping system.
- E. Install piping so that systems can be completely drained. Provide piping systems with valve drain connections at all low pipe and ahead of all sectionalizing valves whether shown on plans or not. Drain lines shall be as follows:

<u>PIPE SIZE</u>	<u>DRAIN SIZE</u>
3/4" thru 2"	3/4"
2-1/2" thru 5"	1"

Drain valves on hot water system shall have lock shields and plugged or capped outlets to protect system from inadvertent drainage.

- F. Pitch all piping and where possible make connections from horizontal piping so that air can be properly vented from system. Provide air vents as specified at all system high points and at drop in piping in direction of flow. Use eccentric fittings as listed in piping schedules. Fitting shall be approved factory made type with threaded or weld ends as required. Fitting pressure and temperature ratings shall be equal to or exceed maximum operating temperature and working pressure of piping system. No mitered or field fabricated pipe fittings will be permitted.
- G. All pipe threads shall meet ANSI Standard B2.1 for taper pipe threads. Lubricated pipe threads with Astroseal teflon thread sealant rated for gas service and lubricating compound is not acceptable. Powdered or made-up compound will not be permitted. Pipe thread compound shall be applied only to male pipe threads.
- H. Welded pipe joints shall be made by qualified welding procedures and welders. Welding electrodes shall be type and material recommended by electrode manufacturer for materials to be welded. All pipe and fittings ends shall be beveled a minimum of 30 degrees prior to welding.
- I. Brazed socket type joints shall be made with suitable brazing alloys. Minimum socket depth shall be sufficient for intended service. Brazing alloy shall be end fed into socket, and shall fill completely annular clearance between socket and pipe or tube. Brazed joints depending solely upon a fillet rather than a socket type joint will not be acceptable.
- J. Soft soldered socket type joints shall be made with 95-5 tin-antimony solder as required by temperature and pressure rating of piping system. Soldered socket joints shall be limited to systems containing non-flammable and non-toxic fluids. Soldered socket-type joints shall be limited to systems containing non-flammable and non-toxic fluids. Soldered socket-type joints shall not be used on piping systems subject to shock or vibration. Soldered joints depending solely upon a fillet rather than a socket-type joint is not acceptable.
- K. Make changes in piping size and direction with approved factory made fittings. Steel pipe and fittings 2-1/2" and smaller shall be threaded type, pipe and fittings 3" and larger shall be weld end type. Provide fittings suitable for at least 125 PSI working pressure or of pressure rating required for maximum working pressure of system whichever is greater.

- L. Where pipe sizes of header or branch water supply piping do not appear on drawings, size piping to plumbing fixtures as follows:

FIXTURE TYPE	MAXIMUM QUANTITY OF FIXTURES	PIPE SIZE	
		CW	HW
Water Closet (Flush Valve)	1	1-1/2	--
Water Closet (Flush Valve)	2	2	--
Water Closet (Flush Valve)	5	2	--
Urinal	1	1	--
Urinal	2	1-1/4"	--
Urinal	6	2	--
Lavatory	1	1/2	1/2
Lavatory	3	3/4	3/4
Lavatory	6	1	1
Service Sink	1	1/2	1/2
Service Sink	4	1	1

3.2 WELDING

- A. Contractor shall be responsible for quality of welding and suitability of welding procedures. All welding shall be in accordance with American Welding Society Standard B3.0 and ANSI Standard B31.1.
- B. Welding shall be done only by welders who have successfully passed welder qualifications tests in previous 12 months for type of welding required. Each welder shall identify his work with a code marking before starting any welded pipe fabrication. Subcontractor shall submit three copies of a list of welders who will work on project listing welders code, date and types of latest qualification test passed by each welder.
- C. Welded joints shall be fusion welded in accordance with Level AR3 of American Welding Society Standard AWS D10.9 "Standard for Qualification of Welding Procedures and Welders for Pipe and Tubing". Welders qualified under National Certified Pipe Welding Bureau will be acceptable.
- D. Bevel all piping and fittings in accordance with recognized standards by flame cutting or mechanical means. Align and position parts so that branches and fittings are set true. Make changes in direction of piping systems with factory made welding fittings. Make branch connections with welding tees or forged weldolets.

3.3 SCHEDULE

<u>SYSTEM</u>	<u>SIZE</u>	<u>TYPE</u>	<u>FITTINGS</u>	<u>DURATION</u>
Heat Pump Water, Above Grade	1/2"-2"	Copper	Copper	75psi/1 hr.
Heat Pump Water, Above Grade	2½"-8"	Steel-40	Steel/Weld*	75psi/1 Hr.
Heat Pump Water, Below Grade	All	HDPE	HDPE	150psi/1 hr.
Condensate Drain	All	Copper-M**	Copper**	

*Victaulic type grooved fittings are acceptable.
 ** Schedule 40 PVC where not in plenum return.

3.4 COORDINATION

- A. Refer to Section 013300 for fabrication drawings requirements. Drawings must be submitted for review and approval in a timely manner prior to ordering, fabricating, or installing piping and pipe accessories.

END OF SECTION 232113

SECTION 232300 – REFRIGERANT PIPING

PART 1 - GENERAL (Reference Section 230500)

PART 2 – PRODUCTS

2.1 PIPING MATERIALS

- A. All piping used on this project shall be manufactured in the United States. No piping will be allowed from any other country.
- B. Piping used throughout project shall conform to the following specifications. Piping shall be plainly marked with manufacturers name and weight. All materials listed may not be required on this project. See piping material schedule at end of this Section for materials to be used for each piping system. Piping materials shall be as follows:
 - 1. Copper Tube Type ACR:
 - a. Provide hard temper nitrogenized copper refrigerant tube conforming to requirements of current ASTM B-88, ANSI H23.1 and ASTM B-280. Tubes shall be Type ACR (Air Conditioning and Refrigeration) as listed in schedule.
 - b. Tubing joints shall be brazed.
 - c. Pipe by Anaconda, Cerro, or Mueller.

2.2 PIPING FITTINGS

- A. Piping fitting used throughout project shall be proper type for installation method used and shall be compatible with piping system material. Fittings listed in piping material schedule shall conform to the following specifications:
 - 1. Wrought Copper Fittings:
 - a. Provide wrought solder joint copper tube fitting conforming to ANSI Standard B16.22
 - b. Fittings by Anaconda, Chase or Nibco.

2.3 PIPING INSTALLATION

- A. Piping systems materials and installation shall conform with the following standards and codes.
 - 1. System: Heating and Air Conditioning Piping
Code: ANSI Standard B31.1.0 "Power Piping"
 - 2. System: Plumbing System Piping
Code: International Plumbing Code – 2006, International Mechanical Code - 2006
- B. Pipe sizes indicated on plans and as specified refer to nominal size in inches for copper tubing, unless otherwise indicated. Pipes are sized to nearest 1/2". In no case shall piping smaller than size specified be used, unless directed by a manufacturer.

- C. Contractor shall provide and be responsible for proper location of pipe sleeves, hangers, supports, and inserts. Install hangers, supports, inserts, etc., as recommended by manufacturer and as specified and detailed on drawings. Verify construction types and provide proper hangers, inserts and supports for construction used. Install inserts, hangers and supports in accordance with manufacturers load ratings and provide for thermal expansion of piping without exceeding allowable stress on piping or supports. Provide solid type hangers and supports where pipe travel exceeds manufacturer's recommendations for fixed hanger and supports.
- D. Install piping parallel with building lines and parallel with other piping to obtain a neat and orderly appearance of piping system. Secure piping with approved anchors and provide guides where required to insure proper direction of piping expansion. Piping shall be installed so that allowable stress for piping, valves and fittings used are not exceeded during normal operation or testing of piping system.
- E. Size and route all refrigerant piping as directed by the Manufacturer. Manufacturer shall provide required installation details to the contractor for installation of all refrigerant piping.
- F. Provide piping materials and wall thickness for specific piping systems as listed in piping schedule at end of this Section.
- G. Piping fitting materials for specific piping systems shall be as listed in piping schedules. Fitting shall be approved factory made type with threaded or weld ends as required. Fittings pressures and temperature ratings shall be equal to or exceed maximum operating temperature and working pressure of piping system. No mitered or field fabricated pipe fittings will be permitted.
- H. Brazed socket type joints shall be made with suitable brazing alloys. Minimum socket depth shall be sufficient for intended service. Brazing alloy shall be end fed into socket, and shall fill completely annular clearance between socket and pipe or tube. Brazed joints depending solely upon a fillet rather than a socket type joint will not be acceptable.
- I. Make changes in piping size and direction with approved factory made fittings. Provide fittings suitable for at least 125 PSI working pressure or of pressure rating required for maximum working pressure of system whichever is greater.

PART 3 – EXECUTION OF TESTING AND CHARGING OF REFRIGERANT LINES

3.1 TESTING

- A. After the system is installed and before any piping is installed, the entire refrigeration circuit must be thoroughly leak tested. The following test procedure is recommended:
 - 1. Remove and plug the connection points of any controls or relief valves that could be damaged by test pressure. Since the compressor is not included in the leak test, front seat both the compressor suction and discharge valves.
 - 2. Open the liquid line shut-off valve at the condenser, any auxiliary valves in the hot gas and liquid lines and the liquid line solenoid valve(s). If the solenoid valve(s) is not equipped with a manual opening device, apply control power to the solenoid(s), opening the valve(s).
 - 3. Connect a cylinder of oil-pumped, dry nitrogen to the frontseat port of the compressor discharge valve, if the valve is so equipped. If not, make the connection at the liquid line charging valve.
 - 4. NOTE: It is important that the pressure of the nitrogen be controlled by a reducing valve. Control is absolutely necessary because the pressure within a full cylinder of nitrogen is in excess of 2,000 psi at room temperature. It is recommended that the nitrogen be charged to the system through the valve of a gauge manifold.
 - 5. Set the pressure regulator on the nitrogen cylinder at 150 psig or the leak test pressure specified by local code.

6. Open the shut-off valve on the cylinder and the valve of the manifold and charge enough nitrogen into the system to raise the pressure to 150 psig, or to the pressure required by local code. Close the manifold valve.
7. Using a rubber or rawhide mallet, tap each solder connection sufficiently hard to start any leak that might subsequently open from thermal expansion and contraction or vibration.
8. Test all pipe joints for leaks. First check the manifold gauge. If the pressure is dropping, a major leak is present.
9. Large leaks are detected by the sound of escaping gas. Smaller leaks are located by brushing each connection with a soap solution and watching for telltale bubbles. Adding a small amount of glycerin to the soap solution improves the bubbling action. Make certain that all joints are inspected thoroughly. Mark carefully any spots where leaks occur.
10. After the bubble test is completed, close the cylinder shut-off valve and bleed the test pressure through the unused part of the manifold. Repair any leaks found.
11. Leaks are repaired by disassembling the connection, cleaning the fitting and remaking. No attempt should be made to repair a leak by simply adding brazing material.
12. After the system is assumed to be free of leaks, charge enough refrigerant through the liquid line charging valve to raise the system pressure to approximately 10 psig. Remove the refrigerant connection and charge enough nitrogen into the system to raise the test pressure to 150 psig, or to the local code requirement.
13. Check all parts of the system with a halide torch, or electronic leak detector. The presence of escaping refrigerant will color the flame of the halide torch green if the leak is small or a dense blue if it is large. An electronic leak detector indicates the presence of a leak by a gauge reading, signal light or an audible sound. If any leaks are found, relieve the test pressure and repair the faulty area. Recharge the system, as described previously, and allow it to remain under pressure for 24 hours. If, at the end of this period, there is no applicable pressure change, the system may be considered free of leaks.
14. NOTE: The system pressure will change approximately 3 psig with each 10°F rise or fall in ambient temperature.
15. With the testing complete, relieve the test pressure and reconnect any valves or controls that were disconnected previously.

3.2 EVACUATION

- A. To speed the evacuation, connect the vacuum pump to as many points of the system as possible. Register the vacuum developed by the pump, a reliable vacuum gauge or an electronic vacuum gauge is connected to the liquid line charging valve. The compressor valves are then cracked off of their backseats, moving the valve disc to an intermediate position between the backseat and the frontseat of the valve. Open the liquid line charging valve.
- B. The vacuum pump is started and operated until a vacuum equivalent to 500 microns is registered by the vacuum gauge.
- C. When the system has been evacuated, close the suction valve on the vacuum pump and then stop the pump. Backseat one of the compressor valves and remove the vacuum pump connection. Through this valve port, charge enough oil pumped dry nitrogen into the system to raise the pressure to atmospheric. Reevaluate the system. Any moisture remaining in the system is absorbed by the dry nitrogen gas and is removed by the second evacuation.
- D. After the 500 micron vacuum reading has been reestablished, close the vacuum pump suction valve and stop the pump. Backseat the compressor valves and allow the system to stand under vacuum for a minimum of 12 hours.
- E. Inspection before charging: perform a preliminary inspection of the system before the charging is started. The following procedure is recommended:

1. Compressor motor lubricated (open compressor): Adequate crankcase oil level (7/8 of the way up on sightglass).
 2. Gauges installed to register suction and discharge pressures, gauge valves open.
 3. Proper voltage at compressor motor.
 4. Proper overload heaters installed in compressor motor starter.
 5. Motor coupling aligned and tightened (open compressor).
 6. It is the responsibility of the person starting the equipment to check all wiring for tightness, control sequence and the electrical interlocks.
 7. The easiest way to check the functioning of the control system is to disconnect the compressor motor leads at the starter and then operate all of the controls, including the safety devices.
 8. Condenser (Air Cooled) Fan Motors lubricated and ready to operate.
 9. Fan rotation correct.
- F. High Side Charging: The initial volume of refrigerant should be charged into the high side of the system, in liquid form, through the liquid line charging valve. The following procedure is suitable for most systems.
- G. Connect a cylinder of refrigerant to the liquid line charging valve. Before tightening the connection at the charging valve, crack the valve on the refrigerant cylinder and allow enough refrigerant gas to escape through the loose connections to purge air from the connecting line. Tighten the connection. Refrigerant charging should not be one man alone unless he can clearly see the compressor and its gauges while he is performing the charging operation.
- H. Close the liquid line shut-off valve.
- I. Close the system electrical disconnect switches and the unit on-off switch. Start the chilled water pump or system fan. This sequence of events will normally energize the control system.
- J. Lower the setting of the conditioned air or chilled water temperature controller. The closing of the controller contacts should start the condenser water pump or the air cooled condenser fan and open the liquid line solenoid valve(s). However, since the system is under vacuum, the low pressure control is open, preventing the compressor from starting at this time.
- K. With the refrigerant cylinder inverted, open the valve on the cylinder and then the liquid charging valve, allowing liquid refrigerant to enter the system. When the refrigerant pressure at the suction side of the compressor rises to the cut-in setting of the low pressure control, the compressor will start. The compressor will then pump refrigerant vapor from the evaporator into the condenser where it will be condensed and stored.
- L. NOTE: The low pressure control may stop the compressor during the charging operation. This is a normal occurrence. The compressor will be restarted in a few moments when suction pressure is again established.
- M. Continue charging until the estimated refrigerant charge has entered the system. At this point, close the liquid line charging valve and the valve on the refrigerant cylinder. Open the liquid line shut-off valve. Observe the liquid flow through the liquid line sightglass. If the flow contains bubbles of flash gas, additional refrigerant is required. Refrigerant is added by again closing the liquid line shut-off valve and repeating the charging procedure. Stop the charging and reopen the liquid line shut-off valve. Small amounts of refrigerant are added in this manner until the sightglass is clear.

- N. Allow the system to continue to operate, frequently checking the liquid line sightglass and the compressor suction and discharge pressure gauge reading should appear high, system load and temperature conditions considered, there is a good possibility that the system is overcharged. To remedy this condition, remove refrigerant in small amounts until the pressure reading returns to normal. Refrigerant is removed by simply opening the refrigerant cylinder and charging valves allowing the liquid to return to the cylinder. It is good practice to leave the refrigerant drum connected to the charging valve until the system has completed a 72 hour test run. This permits the addition or removal of refrigerant, as necessary, to establish proper system charge. The 72 hour test run is discussed in the chapter that follows. Once the system charge is established, remove the charging line and replace the seal cap on the port of the liquid line charging valve.

3.3 LOW SIDE CHARGING

- A. Small amounts of refrigerant may be added to the system in the gaseous state through the backseat port of the compressor suction valve. When refrigerant is to be added in this manner, backseat the suction valve and purge the charging line before tightening the connection at the valve port.
- B. CAUTION: When low side charging, gaseous refrigerant is drawn from the top of the refrigerant container.
- C. Start the compressor, crack the suction valve clear of its backseat and open the valve on the refrigerant container. The compressor will then pump gaseous refrigerant from the container into the system.

PIPING MATERIAL SCHEDULE												
PIPING					FITTINGS		MAXIMUM NORMAL WORKING		FIELD TEST			
SYSTEM	SIZE	TYPE	SCHED.	GRADE	ASTM	MATERIAL	MATERIAL	TYPE	PRESS.	TEMP.	PRESSURE	TIME
Refrigerant Lines**	All	ACR	--	--	B-88	CP	CP	SS	225	30 to 125	300 PSI	1 HR

ABBREVIATIONS: SS-Silver Solder
CP - Copper

** No refrigerant piping shall be installed until an approved refrigerant piping system diagram has been provided by the manufacturer. Contractor shall verify all sizes and routing with manufacturer prior to installation.

Notes:

1. Contractor may not use Tee-Drill branch takeoffs.
2. All piping shall pass pressure testing and shall be inspected by the Contracting Officer prior to the installation of insulation.

END OF SECTION 232300

SECTION 233113 – DUCTWORK

PART 1 – GENERAL

1.1 GENERAL

- A. Construct ductwork as in accordance with the latest edition of the Sheet Metal and Air Conditioning Contractors' Association (SMACNA) HVAC Duct Construction Standards and ASHRAE HVAC systems and Equipment manual, 2000.
- B. Provide fabrication drawings of proposed ductwork and equipment to coordinate with other trades prior to fabrication. Drawings shall establish that ductwork and equipment will fit allotted spaces with necessary clearance for installation and maintenance.
- C. Construct and install ductwork to be completely free from vibration under all conditions of operation. Support and securely anchor ductwork and equipment from structural framing of building. Provide suitable intermediate metal framing where necessary between building structural framing.

PART 2 – PRODUCTS

2.1 DUCTWORK

- A. All rectangular metal ductwork scheduled for interior thermal and acoustical liner is not sized on Drawings to include the proper thickness of insulation. Add 1" or 2" in height and width of ductwork as required to accommodate insulation thickness. Mount specialties such as turning vanes, dampers, etc., to in a manner to maintain continuity of thermal barrier.
- B. Construct system ductwork to conform to latest edition of low pressure duct construction standards of SMACNA HVAC Duct Construction Standards. Refer to AHU schedule for anticipated total static pressure and provide duct construction as applicable. All ductwork downstream of VAV boxes shall be 1" pressure class.
- C. Provide spiral wound duct on all round ductwork 12" and above and on all medium and high pressure ducts with pressure class above 1" W.G. Provide snap-lock on round duct 10" and under.
- D. Sealing of ductwork shall be as follows:
 - 1. Provide Hard Cast Inc. mineral impregnated woven fiber tape and activator/adhesive in accordance with manufacturers' directions on all joints, connections, etc.
- E. "Ductmate" fabricated systems are acceptable if they meet the performance criteria. Fiberglass ductboard systems are not acceptable on this project.

2.2 MATERIAL

- A. Construct ductwork using galvanized sheetmetal of gauges as detailed in the SMACNA.
- B. Ducts serving Type "1" grease hoods shall be black steel, 16 ga. with welded joints. Slope duct toward hood. Provide access doors at all elbows or changes in direction.

PART 3 – EXECUTION

3.1 GENERAL

- A. The installation of the work shall conform to the SMACNA HVAC Duct Construction Standards.
- B. Provide shoe type branch take-offs for rectangular duct and splitter dampers where teeing.

3.2 DUCT TESTING

- A. Duct systems shall be tested for leakage. Any system with excess leakage shall be repaired and retested.

3.3 COORDINATION

- A. Refer to Section 230500 for fabrication drawings requirement. Drawings must be submitted for review and approved in a timely manner prior to ordering, fabricating, or installing ductwork and ductwork accessories.

END OF SECTION 233113

SECTION 233300 - DUCTWORK ACCESSORIES

PART 1 – GENERAL

1.1 SUBMITTALS

- A. Furnish submittals for ductwork accessories used on this project.

PART 2 - PRODUCTS

2.1 SHEET METAL SPECIALTIES

- A. Specialties shall be factory fabricated items. Submit shop drawings on all specialties with shop drawings of ductwork layout. Specialties shall be as follows:
1. Turning Vanes: Single blade vanes mounted 2-1/8" on center on 24 gauge runners. Air turns by Barber- Coleman will be acceptable on low pressure only. Note: Turning vanes to be provided on all supply, return and exhaust duct elbows (except for kitchen hood grease duct).
 2. Dampers: Provide 24 gauge minimum galvanized metal blades supported on duct with metal supports and locked in position with locking type damper arm.
 3. Fire Damper (Round): Prefco type CR frame 100% free area folding blade type with UL approved 165 degree fusible link. Fire Damper (Rectangular): Prefco model 5500 1-1/2 or 3 hr. as shown on plans or equal type BC frame, 100% free area, folding blade type with UL approved 165 degree fusible link. (Fire Damper Rectangular-Low Velocity). Prefco LPB frame with 165 degree fusible link. Install fire dampers in accordance with NFPA-90A and UL Standards 555. Equivalent dampers by Ruskin, Greenheck, Nailor, Air Balance.
 4. Automatic or Backdraft Dampers: Unless dampers are specified with a particular piece of equipment, provide Cesco #BDA low leak or equal with 16 gauge aluminum blade with oiled bearings mounted in steel frame. Blades shall be balanced and connected with tie bar. Provide end seals and blade seals. Equivalent by Ruskin, Louvers & Dampers, Cesco, Greenheck, Air Balance.
 5. Flexible Connections: Metaledge Ventglas prefabricated flexible connection of 3-1/4" wide heat and fire resistant neoprene coated glass fabric with two 3" wide 24 gauge metal strips attached to each edge. Vent Fabrics, Inc., Duro-dyne Corp. or equal.
 6. Access Doors: Provide access doors in ceiling, walls, or floors for access to dampers valves, controls, piping etc., installed under this contract. Doors and frame shall be formed of not lighter than USS #14 gauge steel. Hinges shall be concealed loose pin spring type. Locks shall be flush, screwdriver, cam action type. At security ceiling locations provide an applicable access door with security latch. Doors and frames shall be furnished in prime coat and as manufactured Higgins, Milcor, Donley, Cesco or equal.
 7. Round take-off fittings to medium and high pressure rectangular ductwork in sizes 12" and larger shall be made with Wesco bell mouth fittings or approved equal. Provide manual damper after take-off.
 8. Round take-off fittings to supply diffusers or registers to low pressure supply ductwork shall be Flexmaster #FLDE complete with locking damper and air scoop. Equivalent by Atco, Air Control Products, Enviro-Air.
 9. Low Pressure Flexible Duct: Thermaflex G-KM rated for 2" W.G. maximum positive and 2" W.G. maximum negative pressure and 2500 FPM maximum velocity. UL listed "UL-181 Standards Class I Duct Material" complying with NFPA Standards 90A and 90B. Duct shall be composed of inner polymeric liner duct bonded to coated steel wire helix. Equivalent by Wiremold, Cleavaflex, Flexmaster with fiberglass insulation and vinyl cover. Maximum length shall be 6'-0" and only one 90° elbow is allowed.
 10. High Pressure Flexible Duct: All ductwork upstream of VAV boxes shall be Flexmaster TL-V rated for 12" W.G. maximum positive pressure and 8" W.G. maximum negative pressure. Provide fiberglass insulation and fire retardant vapor barrier.
 11. Fire/Smoke Dampers: Prefco Model #5020 motorized fire/smoke damper with #MB5800 120 volt actuator. Provide A type on low pressure ducts and B type on medium and high pressure duct. Equivalent by Ruskin, Air Balance, Greenheck, Nailor, Cesco. Power open, locked and reset, spring closed.
 12. Penthouses: Carnes #PFLA with neck size as shown on the drawings. Provide 14" roof curb, bird screen and backdraft damper.

PART 3 – EXECUTION

3.1 GENERAL

- A. Provide turning vanes in all rectangular elbows. Provide manual dampers in branch ducts for each diffuser.
- B. Access doors are not indicated on the drawings. Provide access doors where required to access and service all dampers, valves, controls, piping, FCU, exhaust fans, etc.
- C. Attach flexible ductwork to trunk take-off, diffusers and FCU using nylon or stainless steel bands.

3.2 COORDINATION

- A. Refer to Section 230500 for fabrication drawings requirement. Drawings must be submitted for review and approved in a timely manner prior to ordering, fabricating, or installing ductwork or ductwork accessories.

END OF SECTION 233300

SECTION 233416 - EXHAUST SYSTEMS

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

- A. Provide where shown on plans fans as hereinafter specified or equivalent by Cook, Penn, Greenheck, Carnes.

PART 2 – PRODUCTS

2.1 DIRECT DRIVE SIDEWALL MOUNTED PROPELLER FANS - GREENHECK MODEL S-1

A. General Description:

1. Fan arrangement shall be exhaust, see Fan Schedule
2. Sidewall mounted applications
3. Maximum continuous operating temperature 130 Fahrenheit (54.4 Celsius)
4. Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model number and individual serial number

B. Wheel:

1. Propeller shall be aluminum blade riveted to steel hub
2. A standard square key and set screw or tapered bushing shall lock the propeller to the motor shaft
3. Statically and dynamically balanced in accordance with AMCA Standard 204-05
4. The propeller and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency

C. Motors:

1. Motor enclosures: Totally enclosed fan cooled
2. Motors are permanently lubricated, sleeve bearing type on sizes 8-12 and ball bearing type on sizes 14-24 to match with the fan load and furnished at the specific voltage and phase
3. Accessible for maintenance

D. Drive Frame:

1. Drive frame assemblies and fan panels shall be galvanized steel
2. Drive frame shall have welded wire or formed channels and fan panels shall have prepunched mounting holes, formed flanges and a deep formed one piece inlet venture

E. Disconnect Switches:

1. NEMA rated: 1
2. Positive electrical shut-off
3. Wired from fan motor to junction box

F. Options/Accessories:

1. Dampers:
 - a. Type: Motorized
 - b. Prevents outside air from entering back into the building when fan is off
 - c. Balanced for minimal resistance to flow
 - d. Galvanized frames with prepunched mounting holes
2. Wall Housing:

- a. Mounting arrangement: Flush Exterior
 - b. Constructed of galvanized steel with heavy gauge mounting flanges and prepunched mounting holes
 - c. Housing shall include OSHA approved motor guard
 - d. Reduces installation time and provides maximum installation flexibility
3. Wall Collar:
 - a. Constructed of galvanized steel with heavy gauge mounting flanges and prepunched mounting holes
 4. Motor Side Guard:
 - a. Guard type: Standard Guard
 - b. Protective guard completely enclose the motor and drive side of the fan
 - c. Coated with Permatector, a thermal setting polyester urethane
 5. Weatherhood:
 - a. Shall shield wall opening and dampers from rain and snow
 - b. Material type: Aluminum
 - c. Turndown Angle: 45 degrees
 - d. Screen: Birdscreen

PART 3 - EXECUTION

3.1 GENERAL

- A. Install all specified products per the details on the drawings and specific manufacturer's instructions. Provide all required accessories and fittings for complete and functioning systems.
- B. Coordinate all provided roof curbs with structural steel and roofing subcontractors for size, height and attachment.

END OF SECTION 233416

SECTION 233713 - GRILLES, REGISTERS AND DIFFUSERS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Provide grilles, registers, and diffusers where scheduled on Drawings.
- B. Provide submittals of diffusers and grilles used on this project as specified in Section 010100.

PART 2 - PRODUCTS

2.1 GRILLES, REGISTERS AND DIFFUSERS

- A. Provide grilles, registers and diffusers as shown on the Drawings and hereinafter specified. Set all units with rubber gaskets for air tight connection with mounting surface. See drawings for types, sizes, air flow and quantity.
- B. Refer to drawings for manufacturer and model for each type that was the basis of design. Provide equipment that meets the sound, pressure drop, and throw characteristics.
- C. Equivalent grilles, registers and diffusers by Carnes, Price, Titus, Anemostat, Krueger, Tuttle & Bailey, Nailor.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install all registers with curve of louver away from line of sight. Unless noted otherwise, provide duct mounted diffusers and registers with standard margins.
- B. Provide proper mounting supplies and arrangements for areas shown. Devices under 20 lbs shall be connected to the grid. Those over 20 lbs shall be wired to the grid and over 56 lbs shall be wired to the structure.
- C. Contractor shall adjust flow patterns and coordinate devices with architectural ceiling types.

END OF SECTION 233713

SECTION 235400 – FURNACES

PART 1 - GENERAL (Not Applicable)

PART 2 - PRODUCTS

- A. Provide unit as scheduled on plans. Approved units by Trane, Carrier, Lennox, York. Unit manufacturer shall match split system condensing unit and evaporator coil.
- B. Units shall be 90% efficient natural gas condensing type furnaces. Provide a vertical up-flow unit.
- C. Cabinet casing shall be 18 gauge galvanized steel. Factory paint interior and exterior of cabinet.
- D. Provide unit with DX evaporative a-frame cooling coil sized to match the split system condensing unit. Coil shall be cased. Physical dimensions shall match the furnace dimensions.
- E. Provide unit with 3 speed motor
- F. Provide unit with filter rack and filters.
- G. Thermostats shall be a 7-day programmable unit with night set back function. Unit shall change system from heating to cooling automatically. Provide with matching sub-base and lockable heavy duty plastic cover. Trane, White Rodgers or equivalent.

PART 3 - EXECUTION

- A. Mount furnace on angle iron sub-frame at height as required for proper connections of ductwork and filters. Provide neoprene pads below for vibration isolation.
- B. Pipe condensate drain to floor drain.
- C. Field connect thermostat and split system condensing unit.

END OF SECTION 235400.

SECTION 235523 - RADIANT HEATERS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Provide where shown on the plans radiant heating systems as hereinafter specified and indicated on the Drawings.

1.2 SUBMITTALS

- A. Provide submittals for radiant heaters used on this project as specified in Section 013300.

1.3 EQUIVALENTS

- A. Approved equivalents shall be Reznor, Reflect-O-Ray, Re-Verber-Ray.

PART 2 – PRODUCTS

2.1 RADIANT HEATERS

- A. Gas fired two-stage radiant tube heaters shall be furnished and installed in accordance with governing codes and as shown per drawing(s) provided.
- B. Two-stage radiant tube heaters shall be Design Certified by the American Gas Association (AGA) and comply with current Occupational Safety and Health Act (OSHA) Requirements. The heaters low fire and high fire modes of operation must be Design Certified by AGA.
- C. The supplier shall provide a manufacturer's published warranty covering the heater's stainless steel burner for a period of ten (10) years, combustion and radiant emitter tube assembly for a period of five (5) years, and all components utilized in the heater control assembly for a period of one (1) year.
- D. Two-stage radiant tube heaters shall be designed to satisfactorily operate at an inlet pressure of 7 to 14 inches W.C.
- E. Burner Controls
 1. The two-stage radiant tube heater's normal sequence of operation shall include a defined input differential. Heater must be AGA Design Certified to operate at in input differential of at least 30% between the low fire and high fire modes.
 2. Heaters shall be equipped with a direct silicon carbide ignition system with a three (3)-time ignition trial to sensing mode and an infinite trial after sensing mode. Power supplied to each burner shall be 120 VAC, 60 Hz. Flame sensing shall be via an independent sensing rod and circuit.
 3. The control assembly shall be Design Certified by AGA, shall provide main burner regulation, and shall be of the redundant type. Heater controls shall include two safety differential pressure switches: one to monitor exhaust back pressure and one to monitor combustion air flow, so as to provide complete burner shutdown due to insufficient combustion air or flue blockage.
 4. The heater shall incorporate a self-diagnostic ignition module, include and external LED readout display, and recycle the heater after an inadvertent shutdown.
 5. The heater's control system shall be designed to shut off the gas flow to the main burner in the event either a gas supply or power supply interruption occurs.
 6. The heater's air flow control system shall provide a 45 second pre-purge prior to initiating burner operation and a 90 second post-purge upon completion, effectively removing all products of combustion from heat exchanger and/or radiant tubes.

7. Heater control assembly shall include staging indicator lights that define the units operating input ranges.
8. No condensation shall form as a result of combustion in the combustion chamber or radiant tubes while at operating temperatures.
9. The thermostats shall be two-stage operating on 24 volts.
10. Total heater shutdown shall occur in the event of circuit control lockout, including burner operation and combustion air blower. An interruption of power (reset thermostat) will restart the firing sequence.
11. The heater controls shall provide a 90 second post purge as an integral part of the control assembly.

F. Construction

1. Heater's control housing shall be totally enclosed with a corrosion resistant enameled steel exterior. The controls shall be easily serviceably by removing one (1) panel.
2. The main burner assembly shall be constructed of stainless steel.
3. Heater's combustion chamber shall be 3" or 4" O.D. 16ga. aluminized with titanium coated (150-200MBH) or aluminized coated (75-125MBH) steel, finished with a high emissivity rated, corrosion resistant, black coating.
4. Heater's radiant emitter tube shall be 3" or 4" O.D. 16ga. Aluminized steel finished with a high emissivity rated, corrosion resistant, black coating.
5. The heater's combustion chamber and radiant emitter tube shall incorporate a 3" or 4" slip fit connection in which the upstream tube slides into the next tube and is held by a bolted clamp.
6. Safety differential pressure switches shall incorporate atmospheric sensing termination fittings designed to eliminate blockage due to moisture or foreign matter.
7. The silicon carbide igniter shall be readily accessible and serviceable without the use of tools.
8. Reflectors shall be .025 polished aluminum with a multi-faceted design which includes reflector end caps. Reflectors shall be rotatable from 0 to 45 degrees when required. The heater's reflector hanging system shall be designed to permit expansion while minimizing noise and/or rattles. Reflectors shall be assembled to the heater without the use of tools.
9. The heaters shall utilize a downstream turbulator baffle for maximum thermal efficiency.
10. Heaters shall be equipped with a sight glass allowing a visual inspection of igniter and burner operation from the floor.
11. The two-stage radiant tube heaters shall be designed such that, at the customer's option, outside combustion air may be supplied without the use of additional supply fans. An air intake collar shall be supplied as part of the burner control assembly to accept a 3" or 4" O.D. supply duct.

G. Accessories and Options

1. Provide units with programmable thermostats with heavy duty plastic covers, chain hangers, roof vent kit, roof intake kit with birdscreen and gas stop valves.
2. All heaters shall have one reflector, complete with center support.

PART 3 – EXECUTION

3.1 GENERAL

- A. Install systems as shown on the Drawings and specific manufacturer's instructions. Provide all necessary accessories and fittings for complete and functioning systems.

END OF SECTION 235523

SECTION 236200 – PACKAGED COMPRESSOR AND CONDENSER UNITS 5 TONS OR LESS

PART 1 - GENERAL (REFERENCE SECTION 230500)

1.1 GENERAL REQUIREMENTS

- A. Provide where indicated on plans, and herein as specified, direct expansion remote exterior condensing unit with same manufacturer furnace unit.

1.2 EQUIVALENT MANUFACTURERS

- A. Provide condensing units as manufactured by Trane, Carrier, Lennox, York.

1.3 SUBMITTALS

- A. Submit drawings indicating components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Indicate accessories where required for complete system.
- B. Submit product data indicating rated capacities, weights, and specialties and accessories.
- C. Submit manufacturer's installation instructions.

1.4 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data.
- B. Include start-up instructions, maintenance data, controls, and accessories.

1.5 STORAGE AND HANDLING

- A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- B. Protect units from physical damage.

PART 2 - PRODUCTS

2.1 CONDENSING UNIT

- A. Provide condensing unit with heavy gauge integral steel base, hermetic compressor, condenser coil, and motor.
- B. Rated SEER shall not be less than 13.
- C. Provide one year parts and labor warranty on the entire unit.
- D. Unit frame shall be one-piece welded of 18-gauge zinc coated galvanized steel, baked-on enamel finish.
- E. Compressor shall be hermetic, reciprocating with centrifugal oil pump two-point lubrication for each bearing and connecting rod, crankcase heater and well ring type suction and discharge valves rubber-in-shear isolators.
- F. Unit shall have anti-short cycle prevention controls.
- G. Motor shall be suction gas-cooled, internal motor overloads.

- H. Condenser fan shall be vertical discharge with direct drive motor, statically and dynamically balanced, aluminum blades, zinc ball bearings, built-in motor overloads.
- I. Coil shall be aluminum fin mechanically bonded to seamless copper tubing. Factory leak tested at 425 psig.
- J. Provide low ambient accessories to allow operation to 30 degrees F.

2.2 REFRIGERANT PIPING SYSTEM

- A. Refer to Specification Section 232300 – “Refrigerant Piping”.
- B. Provide copper refrigerant piping system as required for a complete and operational system.
- C. Field verify routing requirements. Pipe routing shall be verified by the manufacturer prior to installation.
- D. Holes required for piping, through all walls shall be cleanly core drilled. Insulation shall be run continuous through opening and annulus fitted with backer rod and then caulked to achieve a weather tight penetration.
- E. Manufacturer shall provide final sizing of refrigerant lines.
- F. Provide all required refrigerant and oil.
- G. 410A is refrigerant specified. R-22 is not an acceptable alternate.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units as required by plans, specifications and manufacturer's installation requirements.

END OF SECTION 236200

SECTION 237200 – AIR-TO-AIR ENERGY RECOVERY EQUIPMENTPART 1 – GENERAL (Reference Section 230500)1.1 GENERAL REQUIREMENTS

- A. Provide where shown on plans, roof mounted packaged energy recovery ventilators complete with microprocessor controls as hereinafter specified and indicated in the schedule.
- B. Equivalents by Greenheck, Valent, Des Champs and Engineered Air.

PART 2 – PRODUCTS2.1 ENERGY RECOVERY VENTILATOR WITH HEATING AND COOLING

- A. Energy Recovery Ventilator shall be as manufactured by "Greenheck". Greenheck Model ERCH is used as the basis of design. Units shall be listed per ANSI/UL 1995, Heating and Cooling Equipment. Energy transfer ratings of the energy recovery wheel shall be ARI Certified. Ventilators shall bear the AMCA Certified Rating Seals for Air Performance. Performance shall be as scheduled on plans. Exhaust discharge and outside air intake shall not be located on the same side on roof top units.
- B. Unit shall be of internal frame type construction of galvanized steel. Frame and panels shall be G90 galvanized steel. Unit shall be internally lined with galvanized sheet metal creating a double wall. Where top panels are joined there shall be an overlapping, standing seam to insure positive weather protection. All metal-to-metal seams shall be factory sealed, requiring no caulking at job site. Unit base to be designed for base frame mounting interior to the building.
- D. Unit casing to be insulated with 1 inch fiberglass. Insulation shall meet requirements of NFPA 90A and tested to meet UL 181 erosion requirements. Insulation to be enclosed in double wall construction.
- E. Wheel shall be of the enthalpy type for both sensible and latent heat recovery and be designed to insure laminar flow. Energy transfer ratings must be ARI Certified to Standard 1060 and bear the ARI certification symbol for ARI Air-to-Air Energy Recovery Ventilation Equipment Certification Program based on ARI 1060. Ratings "in accordance with 1060" without certification are not acceptable. Desiccant shall be silica gel for maximum latent energy transfer. Wheel shall be constructed of lightweight polymer media to minimize shaft and bearing loads. Polymer media shall be mounted in a stainless steel rotor for corrosion resistance. Wheel design shall consist of removable segments for ease of service and/or cleaning. Silica gel desiccant shall be permanently bonded to wheel media to retain latent heat capability after cleaning. Wheels with sprayed on desiccant coatings are not acceptable. Wheels with desiccant applied after wheel formation are not acceptable. Energy recovery device shall transfer moisture entirely in the vapor phase. Energy recovery drive belt material shall be high strength urethane and shall be factory installed in a prestretched state, eliminating the need for field belt tension adjustment. Link style belts are not acceptable.
- F. All components shall be easily accessible through removable doors for exhaust, supply, filter, and damper compartments. Energy recovery wheels (smaller than 54 inches) shall be mounted in a slide-out track for ease of inspection, removal, and cleaning.

- G. Centrifugal fans to be double width, double inlet, forward curved type. All blower wheels shall be statically and dynamically balanced. Ground and polished steel fan shafts shall be mounted in permanently lubricated, sealed ball bearing pillow blocks. Bearings shall be selected for a minimum (L10) life in excess of 100,000 hours at maximum cataloged operating speeds. Separate motors for exhaust and supply blowers shall be provided. Adjustable sheaves on belt-driven fans with motors less than 10 hp shall allow independent balancing of exhaust and supply airflows. Fan and motor assemblies are mounted to unit base with neoprene isolators as standard. Fans shall be located in draw-through position in reference to the energy recovery wheel.
- H. Motors shall be energy efficient, complying with EPACT standards, for single speed ODP and TE enclosures. Motors shall be permanently lubricated, heavy-duty type, matched to the fan load and furnished at the specified voltage, phase, and enclosure. Drives shall be sized for a minimum of 150% of driven horsepower. Pulleys shall be of the fully machined cast type, keyed and securely attached to the fan wheel and motor shafts; 10 horsepower and less shall be supplied with an adjustable drive pulley. Energy wheel motors shall have integral overload protection.
- I. Supply and exhaust air filters shall be 2-inch thick pleated fiberglass, 30% efficient and tested to meet UL Class 2. Filter racks shall be die-formed galvanized steel.
- J. All internal electrical components shall be factory wired for single point power connection. All electrical components shall be UL Listed, Approved, or Classified where applicable and wired in compliance with the National Electrical Code. Weatherproof, integral door interlocking disconnect switch, motor starters, control circuit fusing, control transformer for 24 VAC circuit, and terminal strip shall be supplied as standard components in the control center. Motor starters consist of a contactor and Class 20 electronic adjustable overload protection and shall be provided for all motors in the unit.
- K. Direct expansion (DX) shall be factory tested and rated in accordance with ARI 410. Coils shall have copper tubes with permanently expanded aluminum fins, 12 fpi or less. DX coils shall be equipped with distributors to receive expansion valves at the liquid connections.
- L. Unit shall be field equipped with a separate DX split air cooled condensing unit as scheduled. All piping and required refrigeration specialties shall be field provided and installed.
- M. Unit shall have an interior mounted electric post heater capable of providing the capacity and voltage as listed on the drawing schedule. The electric heater shall be SCR electric heat and shall be controlled thru the unit microprocessor controls. Control of the post heater shall include a temperature sensor with field adjustable set point, located in the outdoor air stream. Heat output of the post-heater shall be infinitely variable
- N. The energy recovery ventilator shall be warranted to be free from defects in material and workmanship for a period of one year from the purchase date. The energy recovery wheel shall be warranted to be free from defects in material and workmanship for a period of five years from the purchase date. Motors shall be warranted by the motor manufacturer for a period of one year from the purchase date.

2.3 MICROPROCESSOR CONTROLS WITH HEATING AND COOLING

- A. The controller shall be provided with required sensors and programming for energy recovery unit. Controller shall be factory programmed, mounted and tested. Controller shall have a LCD readout for changing set points and monitoring unit operation.

B. Sequence of Operation:

1. **UNIT START COMMAND:**
 - Factory mounted and wired Outdoor air (D1) and Exhaust air (D2) damper actuators are powered.
 - Exhaust fan starts after a 10-second delay (adjustable).
 - Supply fan starts 5 seconds (adjustable) after the exhaust fan.
 - Heating, cooling and wheel operation per below.

2. **UNIT STOP COMMAND (OR DE-ENERGIZED):**
 - Supply fan, exhaust fan, tempering options and wheel are de-energized.
 - Outdoor air and Exhaust air damper actuators are de-energized and dampers spring return closed.

3. **COOLING SEQUENCE:** The cooling is controlled to maintain the supply temperature set point. The mechanical cooling will be locked out when the outside air is $<55^{\circ}\text{F} - 2^{\circ}\text{F}$ hysteresis, adjustable.

Packaged DX Cooling: DDC will provide a digital signal for 1 or 2 stages of cooling to maintain the supply air set point (adj.). This signal will come wired to the factory provided condensing section.

4. **DEHUMIDIFICATION SEQUENCE:** The cooling is controlled to maintain the cooling-soil set point. The Dehumidification sequence will be locked out when the OA is $<10^{\circ}\text{F}$ above the cold-coil set point. The mechanical cooling will be locked out when the outside air is $<55^{\circ}\text{F} - 2^{\circ}\text{F}$ hysteresis, adjustable.

Packaged DX Cooling: DDC will provide a digital signal for 1 or 2 stages of cooling to maintain the supply air set point (adj.). This signal will come wired to the factory provided condensing section.

5. **REHEAT SEQUENCE:** While the unit is in dehumidification mode, the outdoor air will be reheated via the electric SCR heater for space neutral applications.

6. **HEATING SEQUENCE:** The heating is controlled to maintain the supply temperature set point. The heating will be locked out when the outside air is $>70^{\circ}\text{F} + 2^{\circ}\text{F}$ hysteresis, adjustable, except when required for dehumidification/reheat processes.

7. **SUPPLY SET POINT RESET FUNCTION.** An optional remote Temperature Sensor shall be provided and the controller will adjust the supply temperature set point up/down accordingly to satisfy the desired room temperature. Cooling and heating are determined by a difference in temperature of the room temperature sensor compared to the desired room temperature set point (adj.).

8. **BUILDING FREEZE PROTECTION PLAN:** If the supply air temperature drops below 35°F (adjustable), the controller will de-energize the unit and activate the alarm output after a preset time delay.

9. **ENERGY WHEEL SEQUENCE**
Optional Frost Control: The DDC controller will output a signal when wheel frosting is occurring which is determined by a temperature set point ($\text{OA}<5^{\circ}\text{F}-2^{\circ}\text{F}$ hysteresis, adjustable) and wheel pressure drop increase.

Modulate Wheel: When frosting is occurring, the VFD modulates the wheel down to a slow rotational speed to defrost wheel. Once the pressure drop decreases below the set point, frost mode is de-energized and the wheel returns to full speed.

- C. ALARMS INDICATION: DDC shall have one digital output for remote indication of an alarm condition. DDC outputs will not be connected as part of this project. Alarms shall include:
1. Dirty Filter Alarm: If the outside air or return air filter differential pressure rises above the switch set point (adj.), the differential pressure switch shall signal the DDC to activate an alarm.
 2. Wheel Rotation Alarm: Monitors wheel rotation, and sends a signal to controller (after a 15 second time delay with no rotation) that signals the DDC to activate an alarm.
 3. Supply and Exhaust Air Alarm: DDC monitors provide switch on each blower and displays an alarm in case of blower failure.
 4. Dirty Wheel Alarm: DDC monitors pressure across the wheel and sends an alarm in the case of an increased pressure drop.
 5. DX Alarm: DDC monitors the refrigerant pressure and shuts off refrigeration circuit in the case of high or low refrigerant pressure.
 6. Temperature Sensor Alarm: DDC will send an alarm in the case of a failed air temperature sensor.

D. Accessories

1. Room Temperature Sensor (TS4): The room temperature sensor is a field mounted sensor that can provide a real-time temperature of the space being served. The user will input a desired room temperature setting, and the controller will adjust the discharge temperature of the unit to compensate for changes in room temperature.
2. Room Dehumidistat (S8): The room dehumidistat is a field mounted sensor that can monitor the relative humidity (RH) of the space. If the RH exceeds 60% RH, the dehumidistat will send a signal to the controller to decrease the after-cooling coil temperature. The controller will control the cooling type to achieve the lower after-coil temperature and electric heater until the space dehumidistat is satisfied.
3. Energy wheel rotation sensor.
4. Dirty filter sensor.

2.5 SCHEDULES

- A. See schedule on plans for capacity.

PART 3 - EXECUTION

- 3.1 Provide Factory Representative start-up, system commissioning and associated programming.

END OF SECTION 237200

SECTION 239000 - ARCHITECTURAL VERIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Subcontractor shall consult all Architectural Drawings and specifications in their entirety incorporating and certifying all millwork, furniture, and equipment rough-in including utility characteristics such as voltage, phase, amperage, pipe sizes, duct sizes, including height, location and orientation. Shop drawings incorporating these requirements shall be submitted to the Contracting Officer for approval prior to installation or rough-in.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 239000

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SECTION 260500 - GENERAL PROVISIONS

PART 1 – GENERAL

1.1 SPECIFICATION FORM AND DEFINITIONS

- A. These Specifications are abbreviated form and contain incomplete sentences. Omissions of words or phrases such as "the contractor shall", "shall be", "as noted on the Drawings", "according to the drawings", "a", "an", "the" and "all" are intentional. Omitted words and phrases shall be supplied by inference.
- B. The term "Contracting Officer" wherever used in these specifications, shall mean LATIMER, SOMMERS & ASSOCIATES, P.A., 3639 SW Summerfield Drive, SUITE A, TOPEKA, KANSAS 66614, PHONE 785-233-3232, FAX 785-233-0647.
- C. When a word, such as "proper", "satisfactory", "equivalent", and "as directed", is used, it requires Contracting Officer's review.
- D. "Provide" means furnish and install.

1.2 LOCAL CONDITIONS

- A. Visit site and determine existing local conditions affecting work in contract.
- B. Failure to determine site conditions or nature of existing or new construction will not be considered a basis for granting additional compensation.

1.3 CONTRACT CHANGES

- A. Changes or deviations from Contract, including those for extra or additional work must be submitted in writing for review of Contracting Officer. No verbal orders will be recognized.

1.4 LOCATIONS AND INTERFERENCES

- A. Location of equipment, circuiting, and other electrical work is indicated diagrammatically on the Drawings. Determine exact locations on job, subject to structural conditions, work of other Sections of the specifications, access requirements for installation and maintenance and approval of Contracting Officer.
- B. Study and become familiar with the Drawings of other trades in order to obtain necessary information for figuring installation. Cooperate with work of other trades and install work in such a way as to avoid interference with their work. Minor deviations, not affecting design characteristics, performance or space limitation may be permitted if reviewed by Contracting Officer prior to installation.
- C. Any conduit, apparatus, appliance or other item interfering with proper placement of work as indicated on Drawings, specified, or required, shall be removed and if so shown, relocated and reconnected without extra cost. Damage to work caused by Contractor, Subcontractor, Sub-subcontractors, or workers shall be restored as specified for new work.
- D. Do not scale Drawings for dimensions. Accurately lay-out work from dimensions indicated on the Drawings unless such be found in error.

1.5 PERFORMANCE

- A. Final acceptance of work shall be subject to the condition that all systems, equipment, apparatus and appliances operate satisfactorily as designed and intended. Work shall include required adjustment of systems and control equipment installed under this specification division.

1.6 CAD FILES

- A. Computer files will be available from LS&A to successful bidders and manufacturers for a fee of \$100. A release of liability form will be required along with payment prior to release of files. PDF's shall be made available upon request.

PART 2 – PRODUCTS

2.1 MATERIALS, EQUIPMENT AND SUBSTITUTIONS

- A. The intent of these specifications is to allow ample opportunity for bidder to use its ingenuity and abilities to perform the work to its and the Owner's best advantage, and to permit maximum competition in bidding on standards of materials and equipment required.
- B. Material and equipment provided shall be first class quality, new, unused and without damage.
- C. In general, these specifications identify required materials and equipment by naming one or more manufacturer's brand, model, catalog number and/or other identification. The first named manufacturer or product is used as the basis for design; other manufacturers named must furnish products consistent with specifications of first named product as determined by Contracting Officer. Base bid proposal shall be based only on materials and equipment by manufacturers named, except as hereinafter provided.
- D. Where materials or equipment are described but not named, provide required items of first quality, adequate in every respect for intended use. Such items shall be submitted to Contracting Officer for review prior to procurement.
- E. Prior to receipt of bids, if Bidder wishes to incorporate products other than those named in specifications in his base bid, he shall submit a written request for review of substitutions to Contracting Officer not less than ten working days prior to bid time. Contracting Officer will review requests and acceptable items will be listed in an Addendum issued to principal bidders.
- F. Materials and equipment proposed for substitutions shall be equal to or superior to that specified in construction, efficiency utility, aesthetic design, and color as determined by Contracting Officer whose decision shall be final and without further recourse. Physical size of substitute brand shall be no larger than space provided including allowances for access for installation and maintenance. Requests must be accompanied by two copies of complete descriptive and technical data including manufacturer's name, model and catalog number, photographs or cuts, physical dimensions, operating characteristics and any other information needed for comparison.
- G. In proposing a substitution prior to receipt of bids, include in such proposal cost of altering other elements of project, including adjustments in mechanical/electrical service requirements necessary to accommodate such substitution.
- H. Within ten working days after bids are received, apparent low bidder shall submit to Contracting Officer for approval three copies of a list of all major items of equipment it intends to provide. As soon as practicable, and within 10 working days after award of Contract, submit shop drawings for equipment and materials to be incorporated in work, for Contracting Officer review. Where 10 day limit is insufficient for preparation of detailed shop drawings on major equipment or assemblies, submit manufacturer's descriptive catalog data and indicate date such detailed shop drawings will be submitted along with manufacturer's certification that order was placed within 10 working day limit.

2.2 SHOP DRAWINGS, OPERATION AND MAINTENANCE INSTRUCTIONS

- A. Submit the minimum number of shop drawings of all materials and equipment as specified in the SECTION 010100. Contracting Officer will retain one set.
 - 1. In addition submit 1 set directly to the Commissioning Agent for simultaneous review.
- B. Where catalog cuts are submitted for review, conspicuously mark or provide schedule of equipment, capacities, controls, fitting sizes, etc., that are to be provided. Mark each submitted item with applicable section and paragraph numbers of these specifications, or Drawing sheet number when item does not appear in specifications. Where equipment submitted does not appear in specifications or specified equivalent, mark submittals with applicable alternate numbers, change order number or letters of authorization. Each submittal shall contain at least four sets of original catalog cuts. Each catalog sheet shall bear equipment manufacturer's name and address. All shop drawings on materials and equipment listed by UL shall indicate UL approval on submittal.

- C. Check all shop drawings to verify that they meet specifications and/or drawings requirements before forwarding submittals to the Contracting Officer for their review. All shop drawings submitted to Contracting Officer shall bear Contractor's approval stamp which shall indicate that Contractor has reviewed submittals and that they meet specification and Drawing requirements. Contractor's submittal review shall specifically check for but not be limited to the following: equipment capacities, physical size in relation to space allowed; electrical characteristics. All shop drawings not meeting Contractor's approval shall be returned to its supplier for resubmittal.
- D. No submittals will be considered for review by the Contracting Officer without Contractor's approval stamp, or that have extensive changes made on the original submittal as a result of Contractor's review. All comments or minor notations on shop drawings shall be flagged to indicate originator of comment.
- E. Contracting Officer will not be responsible for or the cost of returning shop drawing submittals that are submitted without Contractor's review and approval stamp. A letter will be sent to Contractor by either the Contracting Officer indicating receipt of an improper submittal for pick-up by Contractor or supplier for 15 working days after date of receipt. If not picked up by the 16th working day, submittals not having Contractor's review and approval stamp will be disposed of by Contracting Officer.
- F. Contracting Officer's review of shop drawings will not relieve Contractor of responsibility for deviations from drawings and specifications unless such deviations have been specifically approved in writing by Owner or its representative, nor shall it relieve Contractor of responsibility for errors in shop drawings. No work shall be fabricated until Contracting Officer's review has been obtained. Any time delay caused by correcting and resubmitting shop drawings will be Contractor responsibility.
- G. Operating and Maintenance Manuals:
 - 1. Submit an outline copy of installation, operating and maintenance manuals for review and comment.
 - 2. Submit three copies in the form of a manual brochure, of installation, operating, maintenance instructions, and parts lists for equipment provided after receiving comments from outline review. Instructions shall be prepared by equipment manufacturer.
 - 3. Keep in safe place, keys and wrenches furnished with equipment under the Contract. Present to Owner and obtain receipt for same upon completion of project.
 - 4. Prepare a complete notebook, covering systems and equipment provided. Submit notebooks to Contracting Officer for review before delivery to Owner. Contractor at its option may prepare this notebook, or retain an individual to prepare it, shall include cost of this service in bid. Notebooks shall contain following:
 - a. Certified equipment drawings/or catalog data with equipment provided clearly marked.
 - b. Complete installation, operating, maintenance instructions and parts lists for each item of equipment.
 - c. A complete set of shop drawings.
 - d. Special emergency operating instructions with a list of service organizations (including addresses and telephone numbers) capable of rendering emergency service to various parts of electrical system.
 - e. A complete reproducible set of as project record drawings at 1/8" = 1'-0" scale showing all electrical systems as installed.
 - f. All required warranties and guarantees.
 - 5. Provide brochures bound in Wilson-Jones No. B3-367-49 or National No. B2-87-784 black vinyl three-ring binders with metal hinge. Reinforce binding edge of each sheet of looseleaf type brochure to prevent tearing from continued usage. Clearly print on label insert of each brochure:
 - a. Project name and address.
 - b. Section of work covered by brochure, e.g., "Power" and "Lighting", etc.

PART 3 – EXECUTION

3.1 CUTTING AND PATCHING

- A. Cutting and patching of building materials required for installation of work herein specified. Cut no structural members without Contracting Officer's approval and in an approved manner.
- B. Patching shall be by mechanics of particular trade involved and shall meet approval of Contracting Officer.

- C. Drilling and cutting of openings through building materials requires Contracting Officer's review and approval. Make openings in concrete with concrete hole saw or concrete drill. Use of star drill or air hammer for this work will is not acceptable.

3.2 MUTILATION

- A. Mutilation of building finishes, caused by demolition or installation of new work shall be repaired at Contractor's expense to approval of Contracting Officer.

3.3 SETTING, ADJUSTMENT AND EQUIPMENT SUPPORTS

- A. Work shall include mounting, alignment and adjustment of systems and equipment. Set equipment level on adequate foundation and provide proper anchor bolts and isolation as shown, specified or required by manufacturers in installation instructions. Level, shim and grout equipment bases as recommended by manufacturer. Equipment failures resulting from improper installation or field alignment shall be repaired or replaced by Contractor at no additional cost to Owner.
- B. Provide floor or slab mounted equipment with 3-1/2" high concrete bases unless shown or specified otherwise.
- C. Provide each piece of equipment or apparatus on the roof, suspended from ceiling or mounted above floor level with suitable structural support, platform or carrier in accordance with best recognized practice. Verify that structural members of buildings are adequate to support equipment and unless otherwise indicated on Drawings or specified, arrange for their inclusion and attachment to building structure. Provide hangers with vibration isolators shown on the Drawings. Submit details of hangers, platforms and supports together with total weights of mounted equipment to Contracting Officer for review before proceeding with fabrication or installation.

3.4 TRAINING

- A. Train Owner's operating personnel at the site to operate and maintain systems and equipment installed. Keep a record of training provided to Owner's personnel listing the date, subject covered, instructors name, names of Owner's personnel attending and total hours of instruction given each individual. Training shall be video taped for future use by the Owner. Submit two copies on all tapes to Owner. Refer to 01651 for additional requirements.

3.5 PRE-FINAL AND FINAL CONSTRUCTION REVIEW

- A. At Contractor's request, Contracting Officer will make pre-final construction review to determine if to the best of its knowledge project is completed in accordance with Contract Documents.
 - 1. Items found by Contracting Officer as not complete or not in accordance with requirements of Contract will be outlined in report to Owner for forwarding to Contractor. Contractor shall complete and/or correct these items, before notifying Contracting Officer it is ready for final review.
- B. All necessary system adjustments including fire alarm system testing shall be completed and all specified records and reports submitted in sufficient time to be received by Contracting Officer at least ten working days prior to date of final construction review.
- C. At final construction review, Contractor shall be present or shall be represented by a person of authority. Each shall demonstrate, as directed by Contracting Officer, that work complies with purpose and intent of contract documents and shall provide labor, services, instruments or tools necessary for such demonstrations and tests.

3.6 WALL PENETRATIONS

- A. Include the installation of all junction boxes, access panels and sleeves for openings required to install work. All floor and wall penetrations shall be sealed to meet fire rating requirements, using materials tested in accordance with ASTM E814.

3.7 ACCESS PANELS

- A. Openings, Access Panels and Sleeves: Include the installation of all boxes, access panels and sleeves for openings required to install this work, except structural openings incorporated in the structural drawings. Sleeves shall be installed for all pipes passing through structural slabs and walls. Set and verify the location of sleeves as shown on structural plans that pass through beams, only if so shown. All floor and wall penetrations be sealed to meet fire rating requirements. Access panels shall include those required to access junction boxes, ballasts, disconnects, pipe chases, etc. Locations and sizes of panels are to be determined by the contractor and are not specifically shown on the drawings.

END OF SECTION 260500

SECTION 260501 - EXTENT OF CONTRACT WORK AND CODES

PART 1 – GENERAL

1.1 GENERAL EXTENT OF WORK INCLUDED

- A. Provide electrical systems indicated on Drawings, specified or reasonably implied. Provide every device and accessory necessary for proper operation and completion of electrical systems. In no case will claims for "Extra Work" be allowed for work about which Contractor could have been informed before bids were taken.
- B. Become familiar with equipment provided which require electrical connections and control. Follow circuiting shown on drawings for power and equipment connections.
- C. Make required electrical connections to equipment provided under Mechanical divisions of this project.
- D. The cost for field modifications requiring rewiring of factory installed control systems for equipment provided shall be included in base bid of the respective contractor.
- E. Check electrical data and wiring diagrams received from mechanical equipment compliance with project voltages, wiring, controls and protective devices shown on electrical drawings. Promptly bring discrepancies found to attention of Contracting Officer for a decision.
- F. Provide safety disconnect switches, contactors, and manual and magnetic motor starters for mechanical and electrical equipment. With exception of factory installed devices, provide safety disconnect switches, contacts and motor starters by one manufacturer to allow maximum interchangeability of repair parts and accessories for these devices.
- G. To maximum extent possible, electrical controls in equipment rooms and control rooms shall be grouped in accessible locations and arranged according to function. Where possible, use group control panels and combination starters in lieu of individually enclosed devices.

1.2 CODES, ORDINANCES, RULES AND REGULATIONS

- A. Conform to latest editions and supplements of following codes, standards or recommended practices.
 - 1. National Electrical Safety Code Handbook H30- National Bureau of Standards
 - 2. Occupational Safety and Health Standard (OSHA) Department of Labor
 - 3. Safety Code for Elevators ANSI A17.1
 - 4. NFPA No. 70 National "Electrical" Code 2008
 - 5. NFPA No. 101 Life Safety Code
 - 6. All materials, equipment and component parts of equipment shall bear UL labels whenever such devices are listed by UL.
 - 7. Uniform Building Code–1997.

1.3 COMMISSIONING –C.A. REQUIREMENTS

- A. Refer to Section 016510 for contractor requirements for Commissioning and start-up. All systems and equipment are to be commissioned unless specifically excluded in Section 016510.

1.4 SEISMIC DESIGN

- A. Refer to Section 230510 for Seismic requirements of Division 16 materials and equipment.

PART 2 - PRODUCTS

2.1 DRAWINGS

- A. Drawings are to be considered diagrammatic for all systems. Conduit runs and circuiting do not show all required offsets and fittings. Contractor shall include in bid costs to provide systems which will avoid and coordinate with all other building trades and systems.
- B. Contractor may not share neutrals or grounds for multiple circuits, unless specifically noted as such on the drawings.
- C. Homeruns may be grouped together.

PART 3 - EXECUTION

3.1 TEMPORARY CONSTRUCTION UTILITIES

- A. Contractor shall provide temporary construction power for all trades along with lighting to accomplish the on-going work. Lighting shall be sufficient for trades to properly function and to provide a safe working environment, as determined by the A-E.

END OF SECTION 260501

SECTION 260502 - BASIC MATERIALS AND METHODS

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

- A. Materials and equipment installed under this contract shall be first class quality, new, unused and without damage.
- B. In general, these specifications identify required materials and equipment by naming one or more manufacturer's brand, model catalog number and/or other identification. The first named manufacturer or product is used as the basis for design; other brands listed are considered equivalent. Equivalent brands by manufacturers named must furnish products consistent with specifications of first named product as determined by Contracting Officer. Base bid shall include only those brands named, except as hereinafter provided.
- C. Where materials or equipment are described but not named, provide required items of first quality, adequate in every respect for intended use. Such items are subject to Contracting Officer's review prior to procurement.

1.2 RECORDING AND REPORTING TESTS AND DATA

- A. Contractor shall submit testing forms for review and comment prior to commencing testing.
- B. Record nameplate horsepower, amperes, volts, phase service factor and other necessary data on motors and other electrical equipment furnished and/or connected under this contract.
- C. Record motor starter catalog number, size and rating and/or catalog number of thermal-overload units installed in all motor starters furnished and/or connected under this contract. See motor starter specification for instructions for proper sizing of thermal-overload units.
- D. Record amperes-per-phase at normal or near-normal loading of each item of equipment furnished and/or connected.
- E. Record correct readings of each feeder conductor after energized and normally loaded, and again after balancing of feeder loads as required by current readings.
- F. Record voltage and ampere-per-phase readings taken at service entrance equipment after completion of project with building operating at normal electrical load. This reading shall be taken continuously for a 24 hour period and recorded on permanent tape and submitted to Contracting Officer.
- G. Record voltage and amperes at transformer secondary and primary stations, at normal loading. Record transformer percentage "taps" finally selected.
- H. Submit at least two (2) typewritten copies of data noted above to Contracting Officer for review prior to final inspection.
- I. Keep a record of all deviations made from routes, locations, circuiting, etc. shown on contract drawings.
- J. Contractor shall perform a comprehensive blackout test.

PART 2 - PRODUCTS

2.1 IDENTIFICATION OF WIRING AND EQUIPMENT

- A. Provide identification and warning signs to wiring and equipment as listed in schedule. Signs and tags shall be as follows:
 - TYPE 1: Laminated phenolic plastic with black Gothic condensed lettering by Seton or Wilco.
 - TYPE 2: Self-sticking flexible vinyl with oil resistant adhesive for minus 20° to 300° F. temperatures by Brady or as approved.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Provide switchboards with Type 1 signs 2-1/2" x 12" indicating switchboard designation and electrical characteristics as noted on drawings. Provide switchboards sections operating at different voltages with Type 1 sign 2" x 8" indicating electrical characteristics of section. Provide each switchboard device with Type 1 sign 1-1/4" x 5" indicating load served.
- B. Provide lighting and power panelboards with Type 1 sign 1-1/4" x 6" indicating panel designation and electrical characteristics. Mount inside of panel door on circuit breaker trim flange just below breakers.
- C. Provide disconnect switches, motor starters and controllers with Type 1 sign 3/4" x 5" indicating equipment served and Brady No. AE-46125 danger sign.
- D. Provide feeders and branch circuit home runs with Type 2 wire marker indicating circuit number and power source. Provide feeders phase identification letter at each terminal point in addition to its circuit number.
- E. Provide Type 2 tape at feeder terminal lugs to switchboards and panelboards. Tape shall indicate conduit size, conductor type and AWG size. Tape shall be located to be easily read with conductors installed.
- F. Provide and use torque marking compound to mark bolts which require specific torquing. This seal must be removable so it can be reapplied after testing or re-torquing in the future.

3.2 EXCAVATION AND BACKFILL

- A. Perform necessary excavating to receive work. Provide necessary sheathing, shoring, cribbing, tarpaulins, etc. for this operation, and remove same at completion of work. Perform excavation in accordance with appropriate section of these specifications, and in compliance with OSHA Safety Standards.
- B. Excavate trenches of sufficient width to allow ample working space, and no deeper than necessary for installation work.
- C. Conduct excavations so no walls or footings are disturbed or injured. Backfill excavations made under or adjacent to footings with lean concrete
- D. Backfill trenches and excavations to required heights with allowance made for settlement. Tamp fill material thoroughly and moistened as required for specified compaction density. Dispose of excess earth, rubble and debris as directed by Contracting Officer.
- E. Refer to Division 2 for additional requirements.

3.3 OPENINGS, ACCESS PANELS AND SLEEVES

- A. Provide boxes, access panels and sleeves for openings required to install this work, except structural openings incorporated in the structural drawings. Sleeves shall be installed for all conduits passing through structural slabs and walls. Set and verify the location of sleeves as shown on structural plans that pass through beams, only if so shown. All floor penetrations be sealed to meet fire rating requirements.

END OF SECTION 260502

SECTION 260519 - WIRES AND CABLES

PART 1 – GENERAL

1.1 SUBMITTALS

- A. Provide submittals for wiring used on this project as specified in Section 01010.

PART 2 – PRODUCTS

2.1 CONDUCTORS

- A. Unless noted otherwise conductors referred to are wires and cable. Provide code grade soft annealed copper conductors with specified insulation type in proper colors to conform with color coding specified. Provide conductors No. 8 gauge and larger stranded and conductors No. 10 gauge and smaller shall be solid.
- B. Use no conductors smaller than No. 12 gauge unless specifically shown or specified. In no case shall feeders and wires be smaller than that shown on Drawings.
- C. Lighting and Receptacle Circuits: Type THHN/THWN, 600 volt, 75 degrees C (167°F) copper thermoplastic insulated building conductor.
- D. Provide conductors by Encore, Essex, Cerro, Southwire, General.
- E. MC cable is not allowed on this project.

PART 3 - EXECUTION

3.1 CONDUCTOR INSTALLATION

- A. Run conductors in conduit continuous between outlets and junction boxes with no splices or taps pulled into conduits.
- B. Neatly route, tie and support conductors terminating at switchboards, motor control centers, panelboards, sound equipment, etc., with Thomas & Betts Ty-Rap cable ties and clamps or equivalent by Electrovert or Panduit.
- C. Make circuit conductor splices with Buchanan crimped-on solderless connectors and snap-on nylon insulators or equivalent.
- D. Make fixture and device taps with Scotchlok self-stripping electrical tap connectors.
- E. Terminate solid conductors at equipment terminal strips and other similar terminal points with insulated solderless terminal connectors. Terminate all stranded conductor terminal points with insulated solderless terminal connectors. Provide Thomas & Betts Sta-Kon insulated terminals and connectors or equivalent by API/AMP, Blackburn, Buchanan or Scotchlok.
- F. Where a total of six or more control and feeder conductors terminate in a multiple device panel or enclosure that has no built-in terminal blocks provide Buchanan 600 volt heavy duty Type HO sectional terminal blocks with mounting channel and No. 23 see-thru covers. Equivalent terminal blocks by General Electric, Square D or Westinghouse.
- G. Wrap conductor taps and connections requiring additional insulation with a minimum of three overlapped layers of 3M scotch vinyl plastic electrical type No. 88 or equivalent.
- H. Contractor may not share grounds or neutrals for multiple circuits, unless specifically noted as such on the drawings. Home runs may be grouped together in common conduits.

3.2 CONDUCTOR COLOR CODING

- A. Provide continuous color coding for feeder, branch and control circuits. Insulation or identification tape color shall be same color for like circuits throughout. Where specified insulation colors are not available in larger wire sizes color code conductor at all accessible locations with Scotch 35 all-weather color code tape.
- B. Identify the same phase conductor with same color throughout.

- C. Provide conductors with color coding indicated. Where more than one standard voltage system is installed provide same colored conductors with indicated tape or stripe to indicate system voltage.

120/208 Volt	Phase A	Black
120/208 Volt	Phase B	Red
120/208 Volt	Phase C	Blue
120/208 Volt	Neutral	White
120/208 Volt	Ground	Green
277/480 Volt	Phase A	Brown
277/480 Volt	Phase B	Orange
277/480 Volt	Phase C	Yellow
277/480 Volt	Neutral	White
277/480 Volt	Ground	Green

END OF SECTION 260519

SECTION 260526 – GROUNDING

PART 1 – GROUNDING

1.1 GENERAL REQUIREMENTS

- A. Supplement grounded neutral of secondary distribution system with equipment grounding system, installed so that metallic structures, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, portable equipment and other conductive items operate continuously at ground potential and provide low impedance path for ground fault currents.
- B. System shall comply with National Electrical Code, modified as indicated on drawings and as specified.

PART 2 – PRODUCT

2.1 CONDUCTORS

- A. Refer to Section 260519 for a description of wires and cables.

PART 3 – EXECUTION

3.1 GROUNDING CONNECTIONS

- A. Provide equipment ground bus in base of low voltage switchboard brazed or otherwise adequately connected by an approved method to at least three ¾" diameter by 10'-0' long ground rods. Rods shall be located a minimum of 20'-0" feet from each other or any other electrode and shall be interconnected by a bare copper conductor brazed to each ground rod below grade. Refer to drawings for size of copper conductor.
- B. Provide bare copper conductor properly connected to not less than 20 linear feet of additional bare copper conductor located within and near the bottom of a concrete foundation that is in direct contact with earth. Provide a minimum of 3" concrete cover over the grounding electrode. Refer to drawings for size of copper conductor.
- C. Provide copper conductor properly connected to water main. Refer to drawings for size of copper conductor.
- D. Connect system neutral ground and equipment ground system to common ground bus.
- E. Ground secondary services at supply side of each individual secondary disconnecting means and at related transformers in accordance with National Electric Code. Provide each service disconnect enclosure with neutral disconnecting means which interconnects with insulated neutral and uninsulated equipment ground sub to establish system common ground point. Neutral disconnecting links shall be located so that low voltage neutral bar with interior secondary neutrals can be isolated from common ground bus and service entrance conductors.
- F. Required equipment grounding conductors and straps shall be sized in compliance with N.E.C. Equipment grounding conductors shall be provided with green type TW 600 volt insulation. Related feeder and branch circuit grounding conductors shall be connected to ground bus with pressure connectors.
- G. Provide low voltage distribution system with a separate green insulated equipment grounding conductor for each single or three-phase feeder. Single phase 120 volt branch circuits for power shall consist of phase neutral and grounding conductors installed in common metallic conduit. Provide flexible metallic conduit for branch circuits with continuous suitable green insulated grounding conductors. Install grounding conductor in common conduit with related phase and/or neutral conductors. Where parallel feeders are installed in more than one raceway, each raceway shall have a green insulated equipment grounding conductor.
- H. Determine number and size of pressure connectors to be provided on equipment grounding bars for termination of equipment grounding conductors in panelboards and other electrical equipment. In addition to active circuits, provide pressure connectors for panel spares and blank spaces.
- I. Provide electrical expansion fitting with an external flexible copper ground securely bonded by approved grounding straps on each end of fitting except where UL approved built-in copper grounding device is provided.
- J. Provide steel conduits which terminate at switchboards, panelboards, and disconnect switches to metallic housing of electrical equipment with ground bushing and connect each bushing with bare copper conductor to ground bus in electrical equipment.

3.2 GROUNDING TEST

- A. Test complete equipment grounding system at each service disconnect enclosure ground bar with Vibroground test unit manufactured by Associated Research Inc. Resistance, without chemical treatment or other artificial means shall not exceed five (5) ohms to ground.
- B. Subcontractor shall oversee grounding tests at successful completion of installation of grounding system and shall submit certified test reports of ground tests to Contracting Officer.

END OF SECTION 260526

SECTION 260533 - CONDUITS & RACEWAYS

PART 1 – GENERAL

1.1 SUBMITTALS

- A. Provide submittals for conduits and raceways used on this project as specified in Section 01010.

PART 2 – PRODUCTS

2.1 STEEL CONDUIT

- A. Galvanized rigid steel conduit: Conduit shall be hot dipped galvanized and shall bear an U.L. label. Conduit shall also meet Federal Specification W-WC-581 and ANSI C80.1.
- B. EMT Conduit: Conduit shall be galvanized steel electrical metallic tubing and bear an Underwriters' Laboratory label. Conduit shall conform to Federal Specification WWC-563 and ANSI specification C80.3.
- C. Contractor shall use rigid steel for elbows and risers in below grade circuiting and in other areas where specifically called for on the drawings.
- D. Contractor may use EMT for all other above grade circuiting.
- E. Contractor may use PVC for all below grade circuiting. Elbows and risers shall be rigid steel.
- F. MC Cable is not acceptable on this project.
- G. Flexible Conduit: Flexible conduit shall have a water resistant non-sleeving polyvinyl chloride jacket with a general temperature range of minus 40°C to 60°C. Conduit shall bear an UL label.
- H. Use flexible conduit for connections to motors and equipment mounted on resilient mounts or vibration isolators.
- I. Fire alarm cabling and low voltage wiring must be run in conduit.
- J. Minimum conduit size shall be 3/4".

2.2 FITTINGS

- A. Rigid Steel Conduit: Couplings shall be steel threaded type and box connectors shall be malleable iron insulated grounding busings and malleable iron or steel locknuts. Unilets shall be malleable iron with blank cover.
- B. EMT Conduit: Couplings shall be steel or malleable iron set screw type. Box connectors shall be malleable iron and malleable iron or steel locknuts. Unilets shall be malleable iron with blank cover.
- C. Flexible Conduit: Connector shall be steel or malleable threaded type iron with grounding ferrule and insulated throat.
- D. Where conduits cross building expansion joints provide O-Z expansion fittings type "AX", "TE", "EX", or "EXE" as required.

2.3 PLASTIC CONDUIT

- A. Provide rigid polyvinyl chloride (PVC) type EPC 40 heavy wall plastic conduit meeting current NEMA Standard TC-2. Conduit shall be listed UL 651 for underground and exposed use.
- B. Plastic conduit may only be used for exterior underground applications or circuits beneath slabs on grade except as noted. Provide rigid steel radius bends and risers for conduits above 1" that rise above grade/slab.
- C. Provide matching plastic fittings. Fittings shall meet the same standards and specifications as the conduit on which it is installed.

- D. Joining and bending of conduit and installation of fittings shall be done only by methods recommended.
- E. Provide interlocking conduit spacers for multiple runs of underground conduits installed in same trench.
- F. Plastic conduit and fittings shall be by a Products Division of Continental Oil Company.
- G. Provide exterior conduit with metal detection strip.
- H. Heavy duty flexible plastic conduit may be used within precast wall panels. Terminate conduit at the panel exit and provide steel piping from that point.

PART 3 – EXECUTION

3.1 CONDUIT INSTALLATION

- A. In general, conceal conduit within walls, floors, roof construction or furred spaces. Expose only feeder and short connections to equipment in equipment rooms unless noted otherwise. Install exposed conduit parallel or at right angle to building lines.
- B. Install conduit to requirements of structure, other work on project and clear of openings, depressions, pipes, ducts, reinforcing steel, etc.
- C. Align conduit terminations at panelboards, switchboards motor control equipment, junction boxes, etc. and install true and plumb. Provide supports or templates to hold conduit alignment during rough-in stage of work.
- D. Install conduit continuous between outlet boxes, cabinets and equipment. Make bends smooth and even without flattening or flaking conduit. Radius of bends shall not be shorter than allowed by the NEC. Long radius elbows may be used where necessary.
- E. Ream and clean conduit before installation and plug or cover openings and boxes to keep conduit clean during construction.
- F. Install no conduits or other raceways sized smaller than permitted in applicable NEC Tables. In no case, reduce conduit sizes indicated on drawings or specified without written approval of Contracting Officer. Fasten conduit securely in place with approved straps, hangers, and steel supports. Provide O-Z cable support to support conductors in vertical raceways as required by NEC.

3.2 INSERTS, HANGERS

- A. Support vertical and horizontal conduit runs at intervals not greater than 10 feet, within 3 feet of any bend and at every outlet or junction box.
- B. Install multiple runs of conduits as follows:
 - 1. Where a number of conduits are to be run exposed and parallel, group and support with trapeze hangers.
 - 2. Fasten hanger rods to structural steel members with suitable beam clamps.
 - 3. Provide beam clamps suitable for structural members and conditions.
 - 4. Provide 3/8" minimum diameter steel hangers rods galvanized or cadmium plated finish.
 - 5. Trapeze hangers shall be Kindorf Series 900 channel with fittings and accessories as necessary. Equivalent by B-line or Powerstrut is acceptable.
 - 6. Attach each conduit to trapeze hanger with Steel City No. C-105 clamps for rigid conduit and Steel City No. C-106 clamps for electrical metallic tubing. (EMT).
- C. Install clamps for single conduit runs as follows:
 - 1. Support individual runs by approved pipe straps, secured by toggle bolts in hollow masonry; expansion shields and machine screws or standard preset inserts in concrete or solid masonry; machine screws or bolts in metal surfaces; and wood screws in wood construction. Use of perforated strap is not acceptable.

3.3 BUSHINGS AND LOCKNUTS

- A. Enter outlet boxes squarely and securely clamp conduit to outlet box with bushing on inside and locknut on outside. Provide threaded malleable iron insulated throat grounding bushings.

- B. Terminate metallic conduits at switchboards, panelboards, control cabinet, etc. with O-Z Electrical Manufacturing Company Type "BL" or "IGB" grounding type insulating bushings. Ground bushings to equipment grounding buss.

3.4 SLEEVES

- A. Furnish proper type and size sleeves to Subcontractor for electrical ducts, busses, conduits, etc. passing through building construction. Supervise installation to insure proper sleeve location. Unless indicated or approved install no sleeves in structural members.
- B. Provide cast iron sleeves extending 1 inch above finished floor where sleeves pass through floors subject to flooding such as toilet rooms, chases, bathrooms, equipment rooms and kitchen. Seal opening between pipe and sleeve with Thunderline Corp. Link Seal.
- C. Unless specified otherwise provide 18 gauge galvanized sheet metal sleeves through floors and non-bearing walls. Where piping passes through exterior walls, equipment room walls, air plenum walls and walls between areas that must be isolated from occupied areas, seal space between sleeves and piping, air or water tight are required with Thunderline Corp. Link Seal.
- D. Provide O-Z Electrical Manufacturing Co., Inc. Type "FSK" or "WSK" or equivalent thruwall and floor seals where conduits pass through concrete foundation walls below grade.
- E. Provide Zurn Z-195 or equivalent flashing sleeve through walls and floors with waterproof membrane. Seal annular space between conduit and sleeve with Thunderline Link Seal or O-Z type CSM sealing bushing.
- F. All holes or voids created by the electrical Subcontractor to extend pipe through fire rated floors and walls shall be sealed with an intumescent material capable of expanding up to 8 to 10 times when exposed to temperatures of 250 degrees F. It shall be ICBO, BOCAI and SBCCI (NRB 243) approved ratings to 3 hours per ASTM E-814 (UL 1479). Acceptable Material: 3M Fire Barrier Caulk, Putty, Strip and sheet forms.
- G. Submit for review a sleeve drawing indicating all required sleeves for conduits or cabling.

3.5 MAINTENANCE HOUSEKEEPING PADS

- A. Provide 3-1/2" thick housekeeping pad where 6 or more conduits penetrate floor slab exposed. This is applicable in equipment rooms where panels are surface mounted.

END OF SECTION 260533

SECTION 260534 - OUTLET, PULL AND JUNCTION BOXES

PART 1 – GENERAL

1.1 SUBMITTALS

- A. Provide submittals for outlet boxes used on this project as specified in Section 01010.

PART 2 – PRODUCTS

2.1 OUTLET BOXES

- A. Provide electrical service outlets with Steel City, Raco, or equivalent four inch code gauge steel knockout boxes galvanized or sheradized of required depth for service or device.
- B. Use of utility or "Handy" boxes are acceptable only where single gang flush outlet box in masonry is "dead-end" with only one conduit entering box from end or back. Single gang masonry boxes acceptable for single device use for receptacles and tele/data in masonry walls.
- C. Use no sectional outlet boxes.
- D. Provide Appleton FS or FD cast boxes for surface mounted exterior work. Provide complete with proper device cover and gasket (refer to Section 16190.) Provide blank cover and gasket when used as junction box.

2.2 PULL BOXES

- A. Provide code gauge pull boxes for installation, sized to conform with NEC rules. Provide complete with necessary fittings, interconnecting nipples, insulating bushings, conductor supports, covers, gaskets, partitions, etc.
- B. Special items may be fabricated to same general design and specifications as those listed in specified manufacturer's catalogs. Provide free of burrs, sharp edges, unreamed holes, sharp pointed screws or bolts, and finished with one coat of suitable enamel inside and out, prior to mounting.
- C. Provide sectional covers for easy removal.

PART 3 - EXECUTION

3.1 LOCATIONS

- A. Coordinate exact location of all devices with other trades and with Contracting Officer. Unless specifically noted otherwise all devices and conduit is to be flush and concealed.

END OF SECTION 260534

SECTION 260548 - ELECTRICAL NOISE AND VIBRATION CONTROL

PART 1 – GENERAL

1.1 DESCRIPTION

- A. This section describes the general requirements of Division 26 of these specifications as they relate to the effective control of noise and vibration generation and propagation through the facility. Work described in this section shall apply to all phases of the work specified, shown on the drawings, or required to provide for complete installation of electrical systems for this project.

1.2 WORK INCLUDED

- A. This work shall include all materials and labor required for the installation and final adjustment of the equipment and materials identified herein. Work will include the following:
 - 1. Conduit Isolation
 - 2. Electrical Equipment Vibration Isolation
 - 3. Utility Cabinet & Outlet Box Penetrations

PART 2 - PRODUCTS

PART 3 – EXECUTION

3.1 CONDUIT ISOLATION

- A. Conduit or other electrical connections to isolated electrical equipment shall be made with lengths of flexible conduit or armored cable. Provide sufficient slack to allow a 360 degree loop at the termination point.
- B. Refer to the drawings for specific details relating to noise control covering applications for specific sections of conduit, or for special isolation requirements.

3.2 UTILITY CABINET AND OUTLET BOX PENETRATIONS

- A. Wall penetrations for electrical outlet boxes shall receive the following treatment during installation.
 - 1. Outlet boxes occurring on both sides of sound rated walls shall be spaced at least two full stud spacings apart in stud wall construction, or 36 inches in masonry wall construction.
 - 2. The wall cavity behind the outlet box shall be tightly packed with lightweight glass fiber, or blown-in mineral fiber insulation.
 - 3. Gypsum board or masonry openings for the outlet box shall be cut no more than 3/8 inch larger than the outlet box dimensions. The gap between the wall opening and the outlet box shall receive a urethane foam acoustical sealant.

3.3 ELECTRIC EQUIPMENT VIBRATION ISOLATION

- A. Transformers shall be mounted on 3/4" neoprene waffle pads.

END OF SECTION 260548.

SECTION 262417 - PANELBOARDS

PART 1 - GENERAL

1.1 SUBMITTALS

- A. Provide submittals for panelboards used on this project as specified in Section 010100.

PART 2 – PRODUCTS

2.1 CIRCUIT BREAKER PANELBOARDS

- A. Provide dead-front panelboards with bolt-in molded case circuit breakers as listed in schedule. Panelboards shall conform to NEMA Standard Publication No. PB-1 and UL Standards No. 50 & 67 for panelboards.
- B. Boxes shall be galvanized steel standard width and depth except where scheduled otherwise. Fronts shall be code gauge steel finished with rust-inhibiting primer and baked enamel finish. Fronts shall have flush doors with flush cylinder tumbler type locks, spring-loaded door pulls, concealed door hinges. Provide doors higher than 48" with three point catch. Panel door locks shall be keyed alike. Provide fronts designed for flush or surface mounting as indicated and attached to box by adjustable trim clamps.
- C. Provide tin-finished aluminum bars full length of panel with rating listed in schedule. Bus bar connection to branch circuit breakers shall be "Phase Sequence" type designed and assembled so circuit breakers can be replaced without disturbing adjacent breakers or removing main bus or branch circuit connectors. Provide bus bars with wire lugs suitable for copper conductors. Provide each panel with equipment grounding bus grounded to box and neutral bus insulated from box.
- D. Branch circuit breakers shall be quick-make, quick-break with trip indication. Circuit breakers shall operate both manually for normal switch functions and automatically under overload and short circuit conditions. They shall provide circuit and self-protection when applied within their rating. Operating mechanisms shall be entirely trip free so that contacts cannot be held closed against a short circuit. Operating handle of circuit breaker shall open and close all poles of a multipole breaker simultaneously. Conforming to NEMA Standards Publications No. PB-1 and be approved by UL. Circuit breaker shall have a thermal magnetic trip unit for each pole for inverse time delayed overload protection and an instantaneous magnetic element for short circuit protection. Trip elements shall operate a common internally connected trip bar to open all poles in case of overload or short circuit through any one pole. Panel shall provide for branch circuit breakers, shall be up to 100 amperes, and unless indicated otherwise shall have 22,000 RMS (120/208V) or 35,000 (277/480V) series rated short circuit amperes symmetrical interrupting capacity. Breakers shall be one, two or three pole type as indicated in panel schedule.
- E. Panels shall have branch circuit directory holders with clear plastic cover. Provide neatly typed list of branch circuit loads corresponding to branch circuit numbers.
- F. Panelboards shall be Square "D" NQOD (120/208V), NF (277/480V) or I-Line as shown on the drawings. Equivalent by ITE, Cutler Hammer, GE.
- G. See panelboard schedules on drawings.

PART 3 – EXECUTION

3.2 INSTALLATION

- A. Install panelboards in accordance with NEC and per the manufacturer's recommendations. Panelboards shall be surface mounted as shown on the drawings and labeled as described in Section 16050.

END OF SECTION 262417

SECTION 262726 - SWITCHES, RECEPTACLES AND COVER PLATES

PART 1 – GENERAL

1.1 SUBMITTALS

- A. Provide submittals for devices used on this project as specified in Section 010100.

PART 2 – PRODUCTS

2.1 QUALITY ASSURANCE

- A. N.E.C. Compliance - Comply with the N.E.C. as applicable to construction installation of electrical wiring devices.
- B. U.L. Compliance and Labeling - Provide electrical wiring devices which have been U.L. listed and labeled.
- C. N.E.M.A. Compliance - Comply with the N.E.M.A. standards for general and specific purpose wiring devices.
- D. Provide factory fabricated wiring devices, in types, colors and electrical ratings for applications indicated and complying with N.E.M.A. standards. Where types and grade are not indicated, provide proper selection as determined by the installer and approved by the Owner to fulfill the wiring device requirements. Provide gray colored devices except as otherwise, selected by the Contracting Officer and verified by the Owner.

2.2 ACCEPTABLE MANUFACTURES

- A. Provide Products Produced By One The Of The Following Manufactures.

Hubbell Inc.	Steel City
Pass & Seymour (P&S)	Midland Ross
Leviton (Lev.)	Raceway Components

2.3 RECEPTACLES

- A. Simplex Receptacles - Provide specification grade, single outlet, 20 amp, 125 volt, N.E.M.A. configuration 5-20R receptacles. With high impact gray nylon faces, back and side wired, heavy duty triple wipe "T" contacts. Hubbell HBL5361G, Pass & Seymour 5361G, Leviton 5361G. See plans for special colors.
- B. Duplex Receptacles - Provide specification grade, 20 amp, 125 volt, N.E.M.A. configuration 5-20R receptacles. With high impact gray faces, back and side wired, heavy duty triple wipe "T" contacts. Hubbell CR5362G, P&S 5362G, Lev. 5362G. Two circuit receptacles shall be the same with the connecting strip removed.
- C. Isolated Ground Receptacles - Provide specification grade, 20 amp, 125 volt, N.E.M.A. configuration 5-20R duplex receptacles with the isolation method as an integral part of the device, high impact orange nylon face, back and side wired, heavy duty triple wipe "T" contacts. Hubbell CR5352IGG, P&S IG600, Leviton 5352IGG.
- D. Illuminated Receptacles - Provide specification grade, 20 amp, 125 volt, N.E.M.A. configuration 5-20R duplex receptacles. With illuminated high impact gray nylon faces and heavy duty triple wipe "T" contacts. Hubbell 5362IL or approved equal.
- E. Ground Fault Receptacles - Provide specification grade, 20 amp, 125 volt, ground fault circuit interrupter duplex receptacles. With a 5 milliampere trip level, feed-thru type, capable of protecting connected downstream receptacles. Hubbell GFR5352, P&S 2091IS, LEV. 8899G.
- F. Weatherproof/GFI Convenience Outlets – Weatherproof Convenience Outlet – Duplex receptacles required to be weatherproof shall be supplied with Hubbel #GFR5352-GYA non-metallic/high impact polycarbonate device for use with GFI receptacle and having a hinged cover to allow for cover to be closed while in use.
- G. Floor Boxes: Floor boxes shall be Wiremold #RFB9 with 6 gang side and 3 gang on other side. 6 gang side shall consist of (6) blank device plates for audio visual. (3) gang side shall consist of (1) isolated ground receptacle, (1) normal power receptacle and (1) tele/data device plate.

2.4 SWITCHES

- A. Single Pole - Provide specification grade, single pole, 20 amp, 120-277 volt, AC gray quiet type switches. Equipped with mounting yoke insulated from the switching mechanism, color coded by amperage tops, back and side wired. Hubbell HBL1221G, P&S 20AC1-G, Lev. 1221-2G.
- B. Double Pole - Provide specification grade, double pole, 20 amp, 120-277 volt, AC gray quiet type switches. Equipped with mounting yoke insulated from the switching mechanism, color coded by amperage tops, back and side wired. Hubbell HBL1222G, P&S 20AC2-G, Lev. 1222-2G.
- C. Three-Way - Provide specification grade, three-way, 20 amp, 120-277 volt, AC quiet type gray switches. Equipped with mounting yoke insulated from the switching mechanism, color code by amperage tops, back and side wired. Hubbell HBL1223G, P&S 20AC3-G, Lev. 1223-2G.
- D. Four-Way - Provide specification grade, 20 amp, 120-277 volt, four-way, AC quiet type gray switches. Equipped with mounting yoke insulated from the switching mechanism, color coded by amperage tops, back and side wired. Hubbell HBL1224G, P&S 20AC4, Lev. 1224-2G.
- E. Pilot Light Switches - Provide specification grade, single pole, 20 amp, 120-277 volt, AC quiet type switches. With a red neon lighted handle to light when the switch is in the "on" position, back and side wired. Hubbell 1221PL, P&S 20AC1-RPL, Lev. 1121-LH-1.

2.5 COVER PLATES

- A. Provide cover plates for all wiring devices. Plates must be compatible with the wiring devices. Provide blank plates as required.
- B. Cover plates for switches, convenience outlets, blank outlets, telephone, etc....shall be stainless steel type 302/304 grade plates. Hubbell S8, P&S S-8N, Lev. 84003-40 series.
- C. Cover plates for emergency receptacles shall be stainless steel with the word "Emergency" in red lettering on it. Hubbell S8MEV, P&S S-8E RED.
- D. Cover plates in unfinished areas shall be galvanized steel.
- E. Labeled plates shall be permanently engraved with appropriate lettering.

PART 3 – EXECUTION

3.1 INSTALLATION OF WIRING DEVICES

- A. Install wiring devices as indicated, in compliance with manufacturer's written instructions, applicable requirements of N.E.C. and N.E.M.A. standards in accordance with recognized industry practices to fulfill project requirements.
- B. Coordinate with other adjacent and associated work as necessary to interface installation of wiring devices.
- C. Install wiring devices only in electrical boxes which are clean, free from excess building materials, dirt and debris.
- D. Install wall mounted receptacles with the ground slot up.

3.2 TESTING

- A. Prior to energizing circuitry, test wiring devices for electrical continuity and proper polarity connections. After energizing circuitry, test wiring devices to demonstrate compliance with requirements.

END OF SECTION 262726

SECTION 262816 - OVERCURRENT PROTECTIVE DEVICES

PART 1 – GENERAL

1.1 SUBMITTALS

- A. Provide submittals for fuses used on this project as specified in Section 010100.

PART 2 – PRODUCTS

2.1 FUSES

- A. Provide fuses of same manufacturer and characteristics as scheduled to insure selective coordination of power system. All fuses shall be listed by Underwriters Laboratories, Inc. with an interrupting rating of 300,000 amperes R.M.S. symmetrical.
- B. Fuses 601 amp and larger shall be UL Class L with minimum four (4) second time delay at 500% rating. (Bussman KRP-C or equal)
- C. Fuses 600 amp and below shall be U/L Class RK1 or RK5 dual element, time delay sized as shown on Drawings (Bussman #LPN, LPS, FRN, and FRS).
- D. Special temperature conditions, motors, motor loads or other conditions requiring other types or sizes of fuses must be reviewed by the Contracting Officer. Fuse reducers are not acceptable.
- E. For fuse types and ampacities, see acceptable Drawings.
- F. Spare Fuses: Deliver the following to Owner's Representative
 - 1. Provide three of each type above 200 amps.
 - 2. Provide 10% of each type 200 amps and below, but not less than 3.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install fuses only after installation is complete and final tests and inspections have been made. Label fuses, switches and other fused devices with warning labels affixed in prominent location indicating type and size of fuse installed and fuse manufacturer's catalog number.

END OF SECTION 262816

SECTION 262817 - DISCONNECT SWITCHES

PART 1 – GENERAL

1.1 SUBMITTALS

- A. Provide submittals for fuses used on this project as specified in Section 010100.

PART 2 – PRODUCTS

2.1 DISCONNECT SWITCHES

- A. Provide heavy duty horsepower rated Safety Switches rated in accordance with NEMA enclosed Switch Standard KS 1-1969 and L98 Standard.
- B. Enclosure shall be NEMA type required by switch location and environment. Enclosure door shall latch with means for padlocking and cover interlock with defeater to prevent opening door when switch is energized or closing switch with door open. Switch shall have an embossed nameplate permanently attached to door front with switch rating, short circuit interrupting capacity and application information.
- C. Line terminals shall be permanently marked and shielded. Contact shall be tin plated, equipped with arch chutes and have moving contacts visible in off position with door open. Wiring terminals shall be pressure type suitable for copper or aluminum wire. Switching mechanism shall be quick-make, quick-break spring driven anti-tease mechanism and be integral part of box. All current carrying parts shall be plated.
- D. Fuse holders shall be high pressure suitable for use with dual element fuses or rejection type current limiting fuses where required. Fuse holders shall be completely accessible from front of switch.
- E. Provide switches by Square "D", Cutler Hammer, ITE, G.E.

PART 3 – EXECUTION

3.1 GENERAL

- A. Mount disconnect switches on equipment as shown on Drawings.

END OF SECTION 262817

SECTION 262913 - MOTOR STARTERS & CONTROLLERS

PART 1 – GENERAL

1.1 SUBMITTALS

- A. Furnish submittals for starters and variable frequency controllers as specified in Section 010100.

PART 2 – PRODUCTS

2.1 MAGNETIC MOTOR STARTERS

- A. Provide 600 volt, 60 hertz AC across-the-line magnetic type rated in accordance with NEMA Standards and listed and labeled in accordance with UL Standard 508 Eleventh Edition.
- B. Enclosures shall be NEMA type required by starter location and environment.
- C. Starter shall have permanently affixed to inside of enclosure cover an easy to read wiring diagram including alternate control variations and also a warning sign indicating maximum current limiting fuses size that may be installed in disconnect switch which will limit fault current to starters withstand rating with 100,000 RMS fault current available at disconnect switch.
- D. Starter contacts shall be silver alloy double break replacement without removal of power wiring or starter from enclosure.
- E. Provide starter with melting alloy or bi-metallic type overload relays on all phases. Overload thermal unit shall be one piece interchangeable construction non-adjustable. Starter shall be inoperative with thermal unit removed. Starters shall not be furnished to Electrical Contractor with jumper straps in overload units.
- F. Thermal units ampere rating for overload relays shall be selected by multiplying motor nameplate running amperes at connected voltage by .90 for motors with 1.0 service and by .95 for motors with 1.15 service factor. Use resulting amperes to enter manufacturer's overload selection tables. Keep record of thermal unit number and current range.
- G. Provide starter with internal wiring and control circuits prewired with only line, load, and external control circuit wiring connections required. When starter voltage exceeds 120 volts, provide 120 volt control circuit transformer with Fusetron Dual Element Fuses in transformer primary.
- H. Starter shall be suitable for addition of at least four electrical interlocks of any arrangement of normally open or closed contacts.
- I. Provide starter with auxiliary contacts to obtain control sequence shown on Drawings or specified. Provide pilot lights and HOA switches on all starters.
- J. Provide magnetic starters by Allen Bradley, Cutler-Hammer, GE, ITE or Square "D".

2.2 COMBINATION MAGNETIC MOTOR STARTERS

- A. Provide 600 volt, 60 hertz AC across-the-line fusible magnetic type rated in accordance with NEMA Standards and listed and labeled in accordance with UL Standard 508 Eleventh Edition.
- B. Starter NEMA enclosure type shall be type required for starter location and environment.
- C. Disconnect switch and magnetic starter shall meet requirements of Articles 2.1 of this section.
- D. Combination starter shall be a factory assembled unit with internal wiring and control circuits prewired with only line, load, and external control circuit wiring connections required.
- E. Provide combination starter by Allen Bradley, Cutler-Hammer, GE, ITE or Square "D".

2.3 MANUAL MOTOR CONTROL (1 HP MAXIMUM)

- A. Provide 300 volt, 60 cycle, AC manually operated motor starting switch meeting current NEMA Standards with proper NEMA enclosure required by starter location and environment.

- B. Starter shall have heavy silver alloy contacts with quick-make, quick-break mechanism manually operated by toggle switch.
- C. Thermal unit shall be melting alloy type, resettable, one piece interchangeable construction.
- D. Provide starter by Allen Bradley, Cutler-Hammer, GE, ITE or Square "D".

2.4 VARIABLE FREQUENCY DRIVES (VFD)

- A. This section provides specification requirements for AC inverter type adjustable frequency, variable speed drives or herein identified as AC drives.
- B. EQUIVALENTS: Square D, Magnatek, Graham, Eaton, Reliance.
- C. WARRANTY
 - 1. A 2-year warranty shall be provided on materials and workmanship from the date of start-up or 30 months from date of shipment.
- D. EQUIPMENT
 - 1. Provide adjustable frequency drive (VFD) solid-state motor control for equipment as shown on plans. All units to be furnished in NEMA 1 enclosures.
 - 2. An integral heavy-duty disconnect switch shall be door-interlocked with provisions for padlocking in the OFF position. Disconnect shall be rated 65000 AIC minimum interrupting capacity.
 - 3. Provide three integral AC chokes on the input of the converter section for enhanced transient suppression. DC reactors or chokes located after the converter section shall in no way satisfy this requirement.
 - 4. Provide 120/1/60 control circuit transformer, fused on both the primary and secondary, for control power. Transformer shall be sized for all internal VFD requirements, plus a reserve of at least 25 VA for customer uses.
 - 5. Magnetic contactor style manual bypasses shall be included with all VFD's. The inverter output and bypass contactors shall be mechanically and electrically interlocked. Electrical interlocking alone is not satisfactory. Both contactors shall be identical in all respects to allow either to be replaced by the other if required. Contactors shall be NEMA or IEC rated, and designed to 1,000,000 operations minimum. A bimetallic thermal overload relay with dial-adjustable heater trip settings shall be included.
 - 6. Provide individual door-mounted electro-mechanical elapsed time meters for each pump to accumulate pump run hours on each motor separately.
 - 7. Supplier shall include jobsite start-up of all VFD's, along with owner training on the operation, maintenance, and trouble-shooting of the system.
- E. FMS COORDINATION
 - 1. The variable frequency drive(s) shall be supplied with the necessary communications option to allow the drive(s) to communicate directly with the Facility Management System via the field-level communications N2 bus. VFD suppliers shall include the N2 communications option as part of the pricing of the VFD's. All control variables and functionality of the VFD's shall be capable of being transmitted via the N2 communications path.
 - 2. The VFD submittal shall list the points that are capable of being transmitted to the automation system. This shall include analog inputs, binary inputs, analog outputs and binary outputs.

PART 3 – EXECUTION

3.1 GENERAL

- A. Install all devices in accessible locations per the manufacturer's recommendations. Refer to drawings for sequences of control.

END OF SECTION 262913

SECTION 263000 – MOTORS

PART 1 – GENERAL

PART 2 – PRODUCTS

2.1 ELECTRIC MOTORS (1/3 HP AND SMALLER)

- A. Motors 1/3 horsepower and smaller shall selected by manufacturer of driven equipment with motor speed and torque characteristics best suited for application.
- B. Motors shall have a minimum service factor of 1.15 for open dripproof enclosure and 1.00 for totally enclosed motors. Wherever applicable provide motors with cushion bases. Motor enclosure shall be proper type required for operating environment.
- C. Motors shall have a plus or minus 10% voltage tolerance and plus or minus 5% frequency tolerance. Motors shall operate satisfactorily in ambient temperature range of 0 degrees C (32°F) to 140°C (104°F) at altitudes below 3300 feet.
- D. Provide motors with built-in thermal overload protection. Motors readily accessible to operating personnel shall have manual reset protector. All other shall have automatic reset protectors.
- E. Motors shall have AFBMA standard double-shielded ball bearings sized for average life of at least 100,000 hours under normal loading conditions. Bearings housing shall have provisions for adding new lubricant without major disassembly and shall have seals to prevent entrance of foreign matter and leakage of bearing lubricant.
- F. Motor bolts, screws and other external hardware shall be treated with a corrosion resistant plating and motor enclosure prime painted with corrosion resistant metal primer finished with a durable machinery enamel.
- G. Unless indicated otherwise motors shall be rated for continuous operation at 115, 200, or 277 volt single phase 60 hertz. Where equipment manufacturer offers a choice provide permanent split capacitor motors in lieu of shaded pole motors.
- H. Motor leads shall be marked throughout entire length for easy identification and terminate with brass or copper terminal lugs. Motor shall have permanently attached nameplate with electrical characteristics and wiring connection diagram.

2.2 ELECTRIC MOTORS (1/2 HP AND LARGER)

- A. Provide equipment requiring electric motors with NEMA Standard motors. Shop drawings, submitted and equipment provided with electric motors shall include motor manufacturer, horsepower, voltage, full load amperes, NEMA design type, insulation class, shaft bearing type, mounting base type, and enclosure type. Motors for this project shall be by one manufacturer.
- B. Motors shall conform to current NEMA Standard MG1. Motor shall operate successfully without derating under the following conditions.
 - 40 degrees C (104°F) maximum ambient temperature.
 - 3,300 Ft. maximum altitude.
 - Voltage variations of plus or minus 10% of nameplate rating.
 - Frequency variations of plus or minus 5% of nameplate rating.
 - Combined voltage and frequency variation of plus or minus 10% total as long as frequency does not exceed plus or minus 5%.
- C. Motors shall meet or exceed locked rotor (Starting) and breakdown (maximum) torques specified for the NEMA design rating. Lock rotor currents shall not exceed NEMA maximum values for motor NEMA design rating. Motor service factors shall be 1.15 for open dripproof motors and 1.00 for totally enclosed motors.
- D. Motor service factors shall be 1.15 for open dripproof motors and 1.00 for totally enclosed motors.
- E. Unless indicated otherwise motor insulation may be manufacturers standard for Class A, B or F provided that maximum permissible temperature for insulation is not exceeded when motor is operating at its service factor load in a 40 Degrees C (104°F) ambient.

- F. Motor frame/HP relationship shall conform to current NEMA Standard for "T" frames. Motors shall have antifriction ball or roller bearings sized for average life of at least 100,000 hours under normal v-belt loading conditions. Bearings shall be AFBMA Standard and shield mounted ball bearings of ample capacity for motor rating. Bearing housing shall have provisions for adding new lubricant and draining out old lubricant without major motor disassembly. Bearing housing shall have seals to protect bearing from entrance of foreign matter and to prevent leakage of bearing lubricant.
- G. Conduit box mounting shall rotate to allow conduit entrance from top, bottom or either side. Conduit holes shall conform to NEC Standards.
- H. Motor leads shall have same insulation class as motor windings. Leads shall be marked throughout entire length for easy identification and terminated with brass or copper terminal lugs. Motor shall have permanently attached nameplate with electrical characteristics and wiring connection diagram.
- I. Motor bolts, screws and other external hardware shall be treated with a corrosion resistant plating. Motor enclosure shall be prime painted with corrosion resisting metal primer and finished with a durable machinery enamel.
- J. Unless indicted otherwise motors shall be rated for continuous operation at rated voltage, three phase, 60 hertz. Motors shall be T-frame squirrel cage induction. Type NEMA design B with Class B insulation. Motors shall be dripproof totally enclosed or explosion-proof as required by motor environment.

PART 3 – EXECUTION

3.1 GENERAL

- A. Motors shall be installed in strict accordance with rules set forth by NEC and equipment manufacturer.

END OF SECTION 263000

SECTION 265100 - LUMINAIRES

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

- A. Provide fixtures complete with lamps and accessories required for hanging. Lamps, reflector lens, and trim shall be clean at time of final inspection. Mount recessed fixtures with trim flush to ceilings, free of gaps or cracks.
- B. Consult architectural plans for ceiling types and provide surface and recessed fixtures with appropriate mounting components and accessories. All exterior fixture colors shall be coordinated and approved by the Contracting Officer.
- C. Where equivalent manufacturers are listed in fixture schedule, fixtures by these manufacturers will be acceptable provided fixture submitted meets or exceeds specified fixtures in performance and construction and appearance.
- D. Provide luminaires at each outlet shown on drawings. Fixture shall be in accordance with type designation on drawings.
- E. Fixture supports shall comply with 2005 NEC Sections 410-15 and 410-16. Provide fixture securing clips as required. Provide #12 wire from opposite corners of each fixture to structure. Wires shall be loose.
- F. Consult lighting plans for locations with dual level switching and provide multiple ballasts as required for inner and outer lamps to be switched separately.

PART 2 – PRODUCTS

2.1 LUMINAIRE SCHEDULE

- A. Refer to schedule on the drawings.

2.2 EQUIVALENTS

- A. Fluorescents – Williams, Lithonia, Day Brite, Metalux, Columbia, LSI, Lightolier.
- B. Fluorescent Downlights - Hubbell, Lithonia, Halo, Prescolite, Lightolier, Kurt Versen, Progress & Infinity.
- C. HID - Hubbell, Lithonia, Spero, GE, Devine & Powerlite, Kim Lighting.
- D. Exits Emergency-Hubbell, Lithonia, Exitronix, Chloride, Light Guard, Prescolite, Dual-Lite.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install fixtures per the manufacturer's recommendations. Fixtures shall be supported independently from the ceiling systems.

END OF SECTION 265100

SECTION 265101 - LAMPS AND LAMP BALLASTS

PART 1 – GENERAL

1.1 GENERAL

- A. Provide lamps for all light fixtures specified for this project. Wattage and lamp type shall be as scheduled on the Drawings.

PART 2 – PRODUCTS

2.1 LAMPS

- A. Fixture lamps shall be lamp type recommended by fixture manufacturer. Lamp no fixtures above manufacturers recommended maximum wattages.
- B. Incandescent lamps shall be inside frosted (IF) type unless otherwise called for in fixture schedule.
- C. Provide General Electric F32T5/SP41 energy saving 4100^oK, Sylvania, or Phillips fluorescent lamps, 2950 approximate initial lumens and CRI of at least 82 (Similar for compact fluorescent).
- D. Metal lamps shall be color corrected type with CRI of at least 70 and of the pulse start design.
- E. Equivalent lamps by Venture, Phillips or Sylvania.

2.2 LAMP BALLASTS

- A. For light fixtures controlled by motion sensors, fluorescent ballasts shall be Advance “centium”, electronic rapid start, T5/32 watt with a total harmonic distortion of 10%. Refer to drawings for locations where 2 ballasts per fixture are required for dual level switching.
- B. For all other light fixtures not controlled by motion sensors, fluorescent ballasts shall be Advance “centium”, electronic instant start, T5/32 watt with a total harmonic distortion of 10%. Refer to drawings for locations where 2 ballasts per fixture are required for dual level switching.
- C. Provide HID fixtures with ballast specifically designed for use with the pulse start HID lamps.
- D. Ballasts for exterior lighting or in areas where fixtures are required to operate below 50 degrees F shall have ballasts designed for low ambient operation.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install lamps in all light fixtures.

END OF SECTION 265101

SECTION 269000 - ARCHITECTURAL VERIFICATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Subcontractor shall consult all Architectural Drawings and Specifications in their entirety incorporating and certifying all millwork, furniture, and equipment rough-in including utility characteristics such as voltage, phase, amperage, pipe sizes, duct sizes including height, location, and orientation. Shop drawings incorporating these requirements shall be submitted to the Contracting Officer for approval prior to installation or rough-in.

PART 2 – PRODUCTS

PART 3 – EXECUTION

END OF SECTION 269000

DIVISION 27 – COMMUNICATIONS

SECTION 270500 – TELECOMMUNICATIONS GENERAL PROVISIONS

SECTION 270533 – CABLE TRAYS

SECTION 271000 – TELECOMMUNICATIONS

SECTION 270500 – TELECOMMUNICATIONS GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 CONTRACT DOCUMENTS

- A. All contract documents including drawings; alternates, addenda and modifications preceding this division of this specification are applicable to contractors, subcontractors, and material suppliers.

1.3 SPECIFICATION FORM AND DEFINITION

- A. These Specifications are abbreviated form and contain incomplete sentences. Omissions of words or phrases such as "the Contractor shall", "shall be", "as noted on the drawings", "according to the drawings", "a", "an", "the" and "all" are intentional. Omitted words and phrases shall be supplied by inference.
- B. Contracting Officer, wherever used in these specifications shall mean LATIMER, SOMMERS & ASSOCIATES, P.A., ENGINEERS, 3639 SW Summerfield Drive, Suite A, Topeka, Kansas 66614, 785-233-3232, FAX 785-233-0647.
- C. Contractor and/or Telecommunications Contractor hereinafter abbreviated T/C, wherever used in these specifications, shall mean the Company that enters into contract with Owner to perform this work.
- D. When a word, such as "proper", "satisfactory", "equivalent", and "as directed" is used, it required Contracting Officer's review.
- E. "Provide" means furnish and install.
- F. Contracting Officer shall mean both the Design Architects and the Design Engineers.
- G. Equipment and/or materials manufacturer hereinafter abbreviated E/M shall mean the manufacturer of equipment or materials specified or referred to.

1.4 QUALIFICATIONS

- A. The contractor(s) responsible for work under this section shall have completed a job of similar scope and magnitude within the last 3 years. They shall provide a list of said projects including Project Name, Project Address, Contact Name, Contact Telephone and Project Status.
- B. The contractor(s) shall employ an experienced, competent and adequate work force licensed in their specific trade and properly supervised at all times. Unlicensed workers and general laborers shall be adequately supervised to insure competent and quality work and workmanship required by this contract and all other regulations, codes and practices.
- C. At all times the contractor(s) shall comply with all applicable local, state and federal guidelines, practices and regulations. Contractor may be required to submit a statement of qualifications upon request before any final approval and selection. Failure to be able to comply with these requirements is suitable reason for rejection of a bid.
- D. The Telecommunications contractor must have vendor approved and certified technicians that will install the cable system. **A copy of certification documents must be submitted with the quote in order for such quote to be valid.** The Telecommunications Contractor is responsible

for workmanship and installation practices in accordance with the specific vendor solution that is proposed. A Technicians Level of training from BICSI or the proposed system solution vendor must be held by at least 30 percent of the termination crew for copper and 10 percent of the termination crew for fiber.

- E. The lead technician on the job site shall be certified by the manufacturer in the installation of the product and /or hold a BICSI, Installer Level II certification.
- F. The T/C shall have a BICSI Certified Registered Communications Distribution Designer (RCDD) employed by their company (on their staff not a contract employee) that will be involved with the installation and project management of the job. The RCDD's name and company must be verifiable on the BICSI website and match the company name of bidder. **A copy of certification documents must be submitted with the quote in order for such quote to be valid.** Telecommunications Contractors that do not have an RCDD on staff may submit a list of (3) project references that include contact information, and project manager qualifications to Contracting Officer prior to bid date to be considered. Submittal of references does not mean the Telecommunications Contractor will be approved to bid. Only the contractors receiving the invitation to bid, listed on a addendum, or approved in writing by Contracting Officer will be considered.
- G. The RCDD shall be required to inspect the installation on a regular basis and submit in writing that they certify the installation to meet all EIA/TIA and NEC standards and codes.
- H. The RCDD shall review the individual cable test results and certify that they are within the acceptable parameters.
- I. The RCDD shall also be required to put into writing that the installation was built per the specifications and construction drawings.

1.5 LOCAL CONDITIONS

- A. Visit site and determine existing local conditions affecting work in contract.
- B. Failure to determine site conditions or nature of existing or new construction will not be considered basis for granting additional compensation.

1.6 CONTRACT CHANGES

- A. Changes or deviations from contract, including those for extra or additional work must be submitted in writing for review of Contracting Officer. No verbal orders will be recognized.

1.7 LOCATIONS AND INTERFERENCES

- A. Locations of equipment, conduit and other telecommunications work are indicated diagrammatically by telecommunications drawings. Layout work from dimensions on Architectural and Structural Drawings. Verify equipment size from manufacturers shop drawings.
- B. Study and become familiar with contract drawings of other trades and in particular general construction drawings and details in order to obtain necessary information for figuring installation. Cooperate with other workers and install work in such a way to avoid interference with their Work. Minor deviations, not affecting design characteristics, performance or space limitation may be permitted if reviewed prior to installation by Contracting Officer.
- C. Should the requirements of work or systems installed by other trades require specific placement of conduit, apparatus, appliances or other telecommunications item, these requirements shall be adhered to. Should these requirements result in major deviations in placement from that indicated on the plans or specifications, the condition shall be reviewed by Contracting Officer prior to the placement of the work.

- D. Any conduit, apparatus, appliance or other telecommunications item interfering with proper placement of other work as indicated on drawings, specified, or required, shall be removed and if so shown relocated and reconnected without extra cost. Damage to other Work caused by this contractor, subcontractor, workers or any cause whatsoever, shall be restored as specified for new work.
- E. Do not scale telecommunications drawings for dimensions. Accurately layout work from dimensions indicated on Architectural drawings unless such is found in error.

1.8 PERFORMANCE

- A. Final acceptance of work shall be subject to the condition that all systems, equipment, apparatus and appliances operate satisfactorily as designed and intended. Work shall include required adjustment of systems and control equipment installed under this specification division.

1.9 WARRANTY

- A. T/C warrants to Owner and Contracting Officer the quality of materials, equipment, workmanship and operation of equipment provided under this specification division for a period of one year from and after completion of building and acceptance of telecommunications systems by Owner.
- B. Contractor warrants to Owner and Contracting Officer that on receipt of notice from either of them within one year of warranty period following date of acceptance all defects that have appeared in materials and/or workmanship, shall be promptly corrected to condition required by contract documents at T/C's expense.
- C. The warranty above expressed shall not supersede any separately stated warranty or requirements required by law or by these specifications.

1.10 ALTERNATES

- A. Refer to General Requirements and description for alternate bid items.

1.11 MATERIALS AND EQUIPMENT SUBSTITUTION

- A. The intent of these specifications is to allow ample opportunity for Contractor to use ingenuity and ability to perform the work to his and Owner's best advantage, and to permit maximum competition in bidding on standards of materials and equipment required.
- B. Material and equipment installed under this contract shall be first class quality, new, unused and without damage.
- C. In general, these specifications identify required materials and equipment by naming first the manufacturer whose product was used as the basis for the project design and specifications. The manufacturer's product, series, model, catalog and/or identification numbers shall set quality and capacity requirements for comparing the equivalency of other manufacturer's products. Where other manufacturer's names are listed they are considered an approved manufacturer for the product specified, however; the listing of their names implies no prior approval of any product they may propose to furnish as equivalent to the first named product unless specific model or catalog numbers are listed in these specifications or in subsequent addenda. Where other than first named products are used for Telecommunications Contractor base bid proposal it shall be the responsibility of the Telecommunications Contractor to determine prior to bid time that the proposed materials and equipment selections are products of approved manufacturers which meet or exceed the specifications and are acceptable to the Contracting Officer.
- D. Where materials or equipment are described but not named, provide required items of first quality, adequate in every respect for intended use. Such items shall be submitted to Contracting Officer for review and approval prior to procurement.

- E. If the Contractor wishes to incorporate products other than those named in the Base Bid Specifications they shall submit a request for approval of equivalency in writing no later than (10) ten calendar days prior to bid date. Substitutions after this may be refused at Contracting Officer option. Equivalentents will ONLY be considered approved when listed by addendum.
- F. Materials and equipment proposed for substitution shall be equal to or superior to that specified in construction efficiency, utility, aesthetic design, and color as determined by Contracting Officer whose decision shall be final and without further recourse. Physical size of substitute brand shall be no larger than space provided including allowances for access, forward two copies of complete descriptive and technical data including manufacturer's name, model and catalog number, photographs or cuts, physical dimensions, operating characteristics and any other information needed for comparison.
- G. Within 10 working days after bids are received, apparent low bidder shall submit to Contracting Officer for approval three copies of a list of all major items of equipment he intends to provide. As soon as practicable and within 3 working days after award of contract, Contractor shall submit shop drawings for equipment and materials to be incorporated in work for Contracting Officer's review. Where 30 working day limit is insufficient for preparation of detailed shop drawings on major equipment or assemblies, Contractor shall submit manufacturer's descriptive catalog data and indicate date such detailed shop drawings will be submitted along with manufacturer's certifications that order was placed within 30 working day limit.

1.12 DRAWINGS, OPERATION AND MAINTENANCE INSTRUCTIONS

- A. Contractor shall furnish a minimum of two (2) sets of shop drawings of all materials and equipment. Contracting Officer will retain one (1) set.
- B. Where catalog cuts are submitted for review, conspicuously mark or provide schedule of equipment, capacities, controls, sizes, etc., that are to be provided. Mark each submitted item with applicable section and paragraph numbers of these specifications, or plan sheet number when item does not appear in specifications or specified equivalent, mark submittals with applicable alternate numbers, change order number or letters of authorization. Each submittal shall contain at least two (2) sets of original catalog cuts. Each catalog sheet shall bear equipment manufacturer's name, address and phone number. All shop drawings on materials and equipment listed by UL shall indicate UL approval on submittal.
- C. Contractor shall check all shop drawings to verify that they meet specifications and/or drawing requirements before forwarding submittals to the Contracting Officer for their review.
- D. All shop drawings submitted to Contracting Officer shall bear Contractor's approval stamp which shall indicate that Contractor has reviewed submittals and that they meet specification and/or drawing requirements. Contractor's submittal review shall specifically check for but not be limited to the following: telecommunications and electrical characteristics, provisions for supply, and drainage connections to building systems. All shop drawings not meeting contractor's approval shall be returned to supplier for resubmittal.
- E. No shop drawing submittals will be considered for review by the Contracting Officer without Contractor's approval stamp, or that have extensive changes made on the original submittal as a result of contractor's review.
- F. Contracting Officer will not be responsible for or the cost of returning shop drawing submittals that are submitted to them without Contractor's review and approval stamp.
- G. Contracting Officer's review of shop drawings will not relieve Contractor of responsibility for deviations from drawings and specifications unless such deviations have been specifically approved in writing by Owner or the representative, nor shall it relieve Contractor of responsibility for error in shop drawings. No work shall be fabricated until Contracting Officer's review has been obtained. Any time delay caused by correcting and resubmitting shop drawings will be Contractor's responsibility.

- H. Submit with shop drawings of equipment, two(2) sets of operating and maintenance instructions and parts lists for all items of equipment provided. Instructions shall be prepared by equipment manufacturer.
- I. Keep in safe place, keys and wrenches furnished with equipment under this contract. Present to Owner and obtain receipt for same upon completion of project.
- J. Prepare a complete brochure, covering systems and equipment provided and installed under his contract. Submit brochures to Contracting Officer for review before delivery to Owner. Contractor at his option may prepare this brochure or retain an individual to prepare it for him. Include cost of this service in bid. Brochures shall contain following:
- K. Certified equipment drawings/or catalog data with equipment provided clearly marked as outlined under Section this specification.
- L. Complete installation, operating, maintenance instructions and parts lists for each item of equipment.
- M. Special emergency operating instructions with a list of service organizations (including addresses and telephone numbers) capable of rendering emergency service to various parts of system.
- N. As-Builts: The Contractor shall mark up a set of contract documents during construction noting all changes and deviations including change orders. These will be delivered to Contracting Officer at end of the project. After the originals are changed to reflect the red line set, a copy shall be included in the brochure. They shall be printed on bond and on compact disk in AutoCAD 2005 format.
- O. Provide brochure bound in black vinyl three-ring binders with metal hinge. Reinforce binding edge of each sheet of loose-leaf type brochure to prevent tearing from continued usage. Clearly print on label insert of each brochure:
 - 1. Project name and address.
 - 2. Section of work covered by brochure, i.e., Telecommunications, Paging, etc. .

1.13 CUTTING AND PATCHING

- A. Contractor shall do cutting and patching of building materials required for installation of work herein specified. Cut no structural members without Contracting Officer's approval and in a manner approved by him.
- B. Patching shall be by mechanics of particular trade involved and shall meet approval of Contracting Officer.
- C. Drilling and cutting of openings through building materials requires Contracting Officer's review and approval. Make openings in concrete with concrete hole saw or concrete drill. Use of star drill or air hammer for this work will not be permitted.

1.14 MUTILATION

- A. Mutilation of building finishes, caused by installation of telecommunications equipment, fixtures, outlets and other telecommunications devices shall be repaired at Contractor's expense to approval of Contracting Officer.

1.15 SETTING, ADJUSTMENT AND EQUIPMENT SUPPORTS

- A. Work shall include mounting, alignment and adjustment of systems and equipment. Set equipment level on adequate foundations and provide proper anchor bolts and isolation as shown or specified. Level, shim, and grout equipment bases as recommended by manufacturer. Equipment failures resulting from improper installation shall be repaired or replaced by Contractor at no cost to Owner.

- B. Provide each piece of equipment or apparatus suspended from ceiling or mounted above floor level with suitable structural support, platform or carrier in accordance with Building Industry Consulting Services International (BICSI) Telecommunications Distribution Methods Manual (TDM) and/or best recognized industry practice. Telecommunications contractor shall arrange for attachment to building structure, unless otherwise indicated on drawings or as specified. Provide hangers with vibration eliminators where required. Contractor shall verify that structural members of building are adequate to support equipment. Submit details of hangers, platforms and supports together with total weights of mounted equipment to Contracting Officer for review before proceeding with fabrication or installation.

1.16 FINAL CONSTRUCTION REVIEW

- A. At final construction review, Telecommunications Contractor and major sub-contractors shall be present or shall be represented by a person of authority. Contractor shall demonstrate, as directed by Contracting Officer, that the work complies with purpose and intent of plans and specifications. Contractor shall provide labor, services, instruments or tools necessary for such demonstrations and tests.

1.17 OPENINGS, ACCESS PANELS AND SLEEVES

- A. Contractor shall provide all boxes, access panels and sleeves for openings required to install his work, except structural openings incorporated in the structural drawings unless noted otherwise. Sleeves shall be installed for all cables passing through structural slabs and walls. Contractor shall set and verify the location of sleeves as shown on structural plans that pass through beams, only if so shown. All floor and wall penetrations shall be sealed to meet fire rating requirements.

END OF SECTION 270500

SECTION 270533– CABLE TRAYS

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Continuous, rigid, welded steel or stainless steel wire mesh cable management system.
- B. Cable tray systems are defined to include, but are not limited to, straight sections, supports and accessories.

1.2 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 17010 Specification Sections, apply to this Section.

1.3 CODES AND STANDARDS

A. References:

1. IEC 61537 (2001) – Cable Tray Systems and Cable Ladder Systems for Cable Management
2. NEMA VE 1-2002/CSA C22.2 No. 126.1-02 – Metal Cable Tray Systems
3. ANSI/NFPA 70 (2005) – National Electrical Code (NEC)
4. TIA 569-A (1998) – Commercial Building Standard for Telecommunications Pathways & Spaces
5. ASTM A 510 - Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel
6. ASTM A 380 – Specification for Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
7. ASTM B 633 – Specification for Electrodeposited Coatings of Zinc on Iron and Steel
8. ASTM A 123 – Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
9. ASTM A 653 - Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality
10. Norm NF/A 91-131 for Galvanized Steel
11. Norm NF/EN 12-329 for Electro-zinc Coating
12. Norm NF/EN/ISO 14-61 for Hot-Dipped Galvanized Steel
13. Norm NF 10-088-2 for Stainless Steel

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain cable tray components through one source from a single manufacturer.
- B. Approval and Labeling: Provide cable trays and accessories specified in this Section that are approved and labeled.
 1. The Terms “Classified” pertaining to cable trays (rather than “Listed”) and “Labeled”: As defined in NFPA 70, Article 100.
 2. Listing and Labeling Agency Qualifications: A “Nationally Recognized Testing Laboratory” as defined in OSHA Regulation 1910.7.
- C. Comply with NFPA 70, National Electrical Code, Article 392: Cable Trays; provide UL Classification and labels.

- D. Comply with IEC 61537, Cable Tray Systems and Cable Ladder Systems for Cable Management.
- E. Comply with NEMA VE 1/CSA C22.2 No. 126.1, Metal Cable Tray Systems, for materials, sizes, and configurations; provide cCSAus Certificate and labels.
- F. Provide documentation of the following certifications:
 - 1. ISO 9001 quality certification.
 - 2. American Bureau of Shipping (ABS) Product Design Assessment certification.
 - 3. Det Norske Veritas (DNV) certification.
 - 4. E 90 Fire Testing certification.
 - 5. VDE certification.
- G. Provide ETL test documentation showing cable compression/deformation testing.
- H. Provide military test documentation showing compliance with the following standards:
 - 1. MIL-S-901D (Navy) –Military Specification, Requirements for Shock Tests, High Impact; Shipboard Machinery, Equipment and Systems
 - 2. MIL-STD-167-1 (Ships) – Military Standards Mechanical Vibrations of Shipboard Equipment

1.5 COORDINATION

- A. Coordinate layout and installation of cable tray with other installations.
 - 1. Revise locations and elevations from those indicated as required to suit field conditions and as approved by the Contracting Officer.
 - 2. Storage and Handling: Avoid breakage, denting and scoring finishes. Damaged products will not be installed. Store cable trays and accessories in original cartons and in clean dry space; protect from weather and construction traffic. Wet materials will be unpacked and dried before storage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS: Subject to compliance with requirements, provide products by the following:

- A. Cablofil, Inc., 8319 State Route 4, Mascoutah, IL, 62258. Phone: (618) 566-3230. Toll-Free: (800) 658-4641. Fax: (618) 566-3250. Website: www.cablofil.com. Email: info@cablofil.com. Or approved equal.

2.2 MATERIALS AND FINISHES:

- A. Cable Tray Materials: select one of the following:
 - 1. Carbon steel wire, ASTM A 510, Grade 1008. Wire welded, bent, and surface treated after manufacture.
- B. Cable Tray Finishes:
 - 1. Finish for Carbon Steel Wire after welding and bending of mesh; select one of the following:
 - a. Electrodeposited Zinc Plating: ASTM B 633, Type III, SC-1.
- C. Cable tray will consist of continuous, rigid, welded steel wire mesh cable management system, to allow continuous ventilation of cables and maximum dissipation of heat, with UL Classified splices where tray acts as Equipment Grounding Conductor (EGC). Wire mesh cable tray will have continuous Safe-T-Edge T-welded top side wire to protect cable insulation and installers.

- D. Provide splices, supports, and other fittings necessary for a complete, continuously grounded system.
1. Mesh: 2 x 4 inches (50 x 100 mm).
 2. Straight Section Lengths: 118 inches (3,000 mm).
 3. Wire Diameter: Patented design includes varying wire sizes to meet application load requirements; to optimize tray strength; and to allow tray to remain lightweight.
 4. Safe-T-Edge: Patented Safe-T-Edge technology on side wire to protect cable insulation and installers' hands.
 5. Fittings: Wire mesh cable tray fittings are field-fabricated from straight tray sections, in accordance with manufacturer's instructions and Item 2.3.
 6. CF Series Cable Tray Size as indicated on the drawings.
 - a. Load Span Criteria:
 - 1) Install and support cable management system in accordance with one of the following:
 - a) IEC 61537, with load span criteria of L/200 (to exceed standard requirements of L/100) and a Safety Factor of 1.7.

2.3 CABLE TRAY SUPPORTS & ACCESSORIES

- A. Fittings/Supports: Wire mesh cable tray fittings are field-fabricated from straight tray sections, in accordance with manufacturer's instructions. Supports will include the FAS (Fast Assembly System) where possible so that screws, bolts, and additional tools are not required for cable tray mounting; installation time is reduced; and tray path can adapt to installation obstacles without the need for additional parts
1. Ceiling-mounted supports mount to ceiling structure directly or with ¼", 3/8" or ½" threaded rod.
 2. Wall-mounted supports.
 3. Splices, including those approved for electrical continuity (bonding), as recommended by cable tray manufacturer.
 4. Accessories: As required to protect, support, and install a cable tray system.

2.4 EQUIPMENT GROUNDING CONDUCTOR FUNCTION & GROUNDING

- A. UL Classified cable trays may act as Equipment Grounding Conductors. Contact Cablofil for approved sizes.
1. Use UL Classified splicing methods as recommended by Cablofil.
 - a. Ground cable trays at end of continuous run.
 - b. Ground continuous cable tray runs every 60 feet.
 2. Cable trays that are not UL Classified will be grounded per NEC requirements and manufacturer recommendations.
 - a. Ground cable trays against fault current, noise, lightning, and electromagnetic interference by mounting grounding wire to each 10' cable tray section with grounding clamp, Cablofil Model GNDCL.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of cable trays. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install cable tray level and plumb according to manufacturer's written instructions, original design, and referenced standards.
 - 1. Cutting: Field-fabricate changes in direction & elevation by cutting & bending cable tray.
 - a. Cut cable tray wires in accordance with manufacturer's instructions.
 - b. Cable tray wires must be cut with side-action bolt cutters with offset head to ensure integrity of protective galvanic layer.
 - c. Remove burrs and sharp edges from cable trays.
 - 2. Certified Installers: Cable tray installers must have successfully completed Cablofil's Certified Installer program.

END OF SECTION 270533

SECTION 271000 - TELECOMMUNICATIONS

PART 1 - GENERAL (REFERENCE SECTION 270500)

1.1 SCOPE

- A. General: Provide communications cabling (voice, data, and video) and associated connecting equipment to all locations within the building in accordance with industry standards and the requirements of the Drawings and Specifications.
- B. This document describes the products and execution requirements relating to furnishing and installing the telecommunications cabling. Horizontal cabling comprised of copper and backbone cable comprised of copper and fiber and the respective support systems are covered under this document.
- C. The Horizontal (workstation) Cabling System shall consist of 4-pair Unshielded Twisted Pair (UTP) Copper Cables to each work area outlet as noted on construction documents for specific locations. Cables shall be installed from the Work Area Outlet to the Telecommunications Room (TR). In the Telecommunications Room, they shall be routed to the appropriate rack and terminated as specified in this document.
- D. All cables and related terminations, support and grounding hardware shall be furnished, installed, wired, tested, labeled, and documented by the Telecommunications Contractor as detailed in this document and the project drawings.
- E. Product specifications, general design considerations, and installation guidelines are provided in this document. Typical installation details, cable routing and outlet location and types will be provided on the project drawings, an attachment to this document. If the bid documents are in conflict, this specification shall take precedence. The successful vendor shall meet or exceed all requirements for the cable system described in this document.

1.2 SUBMITTALS

- A. Product Data: Provide manufacturer's technical product data illustrating size, shape, color, number of conductors, product assembly, product configuration, method of mounting, and other typical characteristics common to the item specified. This data sheet shall include the physical specifications as well as the electrical and transmission characteristics.
- B. Testing: Provide verification, in writing, that all cable conductors being furnished and installed will be tested. Include information indicating who, by name, will certify test results on the system; provide copies of Building Industry Consulting Service International (BICSI) Registered Communications Distribution Designer (RCDD) on Contractor's staff. They shall also provide verification in print that all cable test results have and certify the system, and who will perform the warranty period services.
- C. Material Provided: The successful vendor shall be certain that all correct parts are ordered per Products Section of this document and installed in accordance with manufacturers design and installation guidelines. Vendor shall submit complete parts and part numbers to customer's Project manager prior to installation of equipment. The successful vendor shall be responsible for providing all items necessary to render this a complete system. This shall include but not be limited to the following:
 - 1. All wire and cable: to include patch cords, cross-connect wire and cross-connect cordage.

2. All connectors and required tooling.
 3. All termination system components for each cable type.
 4. All grounding system components.
- D. Product and Applications Assurance: The product implemented in the total system solution must also provide a product warranty and system assurance for a period of not less than 20 years. A certificate validating the warranty and system assurance must be provided to the customer within thirty days of the project completion. Final payment on project will be withheld pending receipt of the certificate.
- E. Complete documentation regarding the manufacturer's warranty shall be submitted as part of the proposal. This shall include, but is not limited to: a sample of the warranty that would be provided to the customer when the installation is complete and documentation of the support procedure for warranty issues.
- F. Under the provisions of this request for proposal, prior to the start of work the telecommunications contractor shall:
1. Submit copies of the certification of the company and names of staff that will be performing the installation and termination of the installation to provide proof of compliance of this specification.
 2. Submit proof from manufacturer of contractor's good standing in manufacturer's program.
 3. Submit appropriate cut sheets for all products, hardware and cabling if different from the products that are called out in this specification.
- G. Work shall not proceed without the Owner/Owner's Representative approval of the submitted items.
- H. The telecommunications contractor must receive written approval from the Contracting Officer on all substitutions of material. Substituted materials shall not be installed except by written approval from the Contracting Officer.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Delivery: Deliver materials to the job site in manufacturer's original unopened containers, clearly labeled with the manufacturer's name and equipment model identification number.
- B. Storage and Handling: Store and protect equipment in a manner that will preclude damage. Cable shall be stored according to manufacturer's recommendations as a minimum. In addition, cable must be stored in a location protected from vandalism and weather. If necessary, cable shall be stored off site at the contractor's expense.
- C. If the telecommunications contractor wishes to have a trailer on site for storage of materials, arrangements shall be made with the Owner/Owner's Representative.

1.4 QUALIFICATIONS

- A. Contractor: The contractor selected to provide the installation of this system shall be certified by the manufacturing company. They shall have a BICSI certified RCDD on staff that will be involved in the installation and project management on a frequent and routine basis. They shall also have a minimum of five (5) years experience on similar cabling systems. The contractor must have vendor approved and certified technicians that will install the cable system. A copy of certification documents must be submitted with the quote

in order for such quote to be valid. The contractor is responsible for workmanship and installation practices in accordance with the specific vendor solution that is proposed. A Technicians Level of training from BICSI or the proposed system solution vendor must be held by at least 30 percent of the termination crew for copper and 10 percent of the termination crew for fiber.

- B. Contractor Resume: A resume of qualification shall be submitted with the Contractor's proposal indicating the following (If requested by the Owner or Contracting Officer):
 - 1. A list of recently completed projects of similar type and size with contact names and telephone numbers.
 - 2. A list of test equipment proposed for use in verifying the installed integrity of metallic and fiber optic cable systems on this project.
 - 3. A list of technical product training, attended by the contractor's personnel that will install the system.
 - 4. Any sub-contractor that will assist the successful contractor in performance of this work.
- C. The contractor(s) shall employ an experienced, competent and adequate work force licensed in their specific trade and be properly supervised at all times. Unlicensed workers and general laborers shall be adequately supervised to insure competent and quality work and workmanship required by this contract and all other regulations, codes and practices.
- D. At all times the contractor(s) shall comply with all applicable local, state and federal guidelines, practices and regulations. Contractor may be required to submit a statement of qualifications upon request before any final approval and selection. Failure to be able to comply with these requirements is suitable reason for rejection of a bid.

1.5 REQUIREMENTS FOR CABLE ROUTING AND INSTALLATION

- A. Cabling: All communications cabling used throughout this project shall comply with the requirements as outlined in the National Electric Code (NEC®) Articles 725, 760, 770, and 800 and the appropriate local codes. All copper and fiber optic cabling shall bear CMP (Plenum Rated), and/or appropriate markings for the environment in which they are installed.
- B. All work and materials shall conform in every detail to the rules and requirements of the National Fire Protection Association, the local Electrical Code and present manufacturing standards.
- C. All materials shall be UL Listed and shall be marked as such. If UL has no published standards for a particular item, then other national independent testing standards shall apply and such items shall bear those labels. Where UL has an applicable system listing and label, the entire system shall be so labeled.
- D. The performance of all modular jacks, patch cords, consolidation points, and patch panels shall be Category 6 components and channel compliant.
- E. The cabling system described in this is derived from the recommendations made in recognized telecommunications industry standards. The following documents are incorporated by reference:
- F. ANSI/TIA/EIA - 568-B.1, Commercial Building Telecommunications Cabling Standard Part 1: General Requirements, April, 2001

- G. ANSI/TIA/EIA - 568-B.2, Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted-Pair Cabling Components, April, 2001
- H. ANSI/TIA/EIA - 568-B.2-1, Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted Pair Cabling Components, Addendum 1 – Transmission Performance Specifications for 4-pair 100 Ω Category 6 Cabling
- I. ANSI/TIA/EIA - 568-B.3, Commercial Building Telecommunications Cabling Standard Part 3: Optical Fiber Cabling Components, March, 2000
- J. ANSI/TIA/EIA – 569-A, Commercial Building Standard for Telecommunications Pathways and Spaces, February, 1998
- K. ANSI/TIA/EIA – 570-A, Residential Telecommunications Cabling Standard, October, 1999
- L. ANSI/TIA/EIA – 606 - A, Administration Standard for Telecommunications Infrastructure of Commercial Buildings, February, 2002
- M. ANSI/TIA/EIA – 607, Commercial Building Grounding and Bonding Requirements for Telecommunications, August, 1994
- N. ANSI/ TIA/EIA – 758, Customer-Owned Outside Plant Telecommunications Cabling Standard, April 1999
- O. BICSI - TDMM, Building Industries Consulting Services International, Telecommunications Distribution Methods Manual (TDMM) – 9th Edition, 2000
- P. National Fire Protection Agency (NFPA – 70), National Electrical Code (NEC) -2002
- Q. If this document and any of the documents listed above are in conflict, then the more stringent requirement shall apply. All documents listed are believed to be the most current releases of the documents. The Contractor has the responsibility to determine and adhere to the most recent release when developing the proposal for installation.
- R. This document does not replace any code, either partially or wholly. The contractor is responsible for adherence of all codes, including local codes, which may affect this project.

1.6 SYSTEM DESCRIPTION

- A. The cabling installed on this project will integrate with the existing telecommunications system. It shall be comprised of Category 6 cabling. Cables and terminations shall be provided and located as shown and in the quantities indicated on the drawings. All cables and terminations shall be identified at all locations. All cables shall terminate in an alphanumeric sequence at all termination locations. All copper cable terminations shall comply with, and be tested to TIA/EIA 568B standards for Category 6 installations. Available and unused pairs shall be identified as spare at each location.

1.7 APPROVED PRODUCTS

- A. Approved products are specified in this document for the horizontal and backbone systems. Specific product and item numbers are defined in the Telecommunications Hardware Schedule of the Telecommunications Cabling Schedule on the contract documents.

1.8 WORK INCLUDED

- A. The work included under this specification consists of furnishing all labor; equipment, materials, supplies and performing all operations necessary to complete the installation and render it functional in compliance with the specifications and drawings. The contractor will provide and install all of the required material to form a complete system whether specifically addressed in the technical specifications or not.
- B. The work shall include, but not be limited to the following:
 - 1. Furnish, install and terminate a complete communications infrastructure including wall plates, jacks, patch panels, wire management panels, patch cords, and any other material required to form a complete system.
 - 2. Perform link testing (100% of horizontal and/or backbone links/channels) and certification of all components.
 - 3. Furnish test results of all cabling to the Owner/Owner's Representative on compact disk and paper format, listed by each closet, then by workstation ID.
 - 4. Adhere and comply with all requirements of the manufacturer of the products proposed in this specification.
 - 5. Provide owner orientation of the overall cable system and cable system documentation. (As-built drawings)

1.9 QUALITY ASSURANCE

- A. The telecommunications contractor shall be a company specializing in communication cabling installation. The telecommunications contractor shall have a Building Industry Consulting Service International (BICSI) Registered Communications Distribution Designer (RCDD) on staff that will be involved with the installation and management of the project. Building Industry Consulting Services International (BICSI), or the proposed system solution vendor, must certify 30 percent of the termination crew for copper and 10 percent of the termination crew for fiber with a Technicians Level of Training,

1.10 DRAWINGS

- A. It shall be understood that the telecommunication details and drawings provided with the specification package are diagrammatic. They are included to show the intent of the specifications and to aid the telecommunications contractor in bidding the job. The telecommunications contractor shall make allowance in the bid proposal to cover whatever work is required to comply with the intent of the plans and specifications.
- B. The telecommunications contractor shall verify all dimensions and be responsible for there accuracy.
- C. Before submitting the bid, the telecommunications contractor shall call to the attention of the Contracting Officer any materials or apparatus the telecommunications contractor believes to be inadequate and to any necessary items of work omitted.

1.11 WARRANTY

- A. An Extended Product Warranty shall be provided which warrants functionality of all components used in the system for a minimum of 20/25 years from the date of registration. The Extended Product Warranty shall warrant the installed horizontal and/or backbone copper and fiber.

- B. The Application Assurance Warranty shall cover the failure of the wiring system to support the applications that are designed for the link/channel specifications of ANSI/TIA/EIA-568-B.1. These applications include, but are not limited to, 10BASE-T, 100BASE-T, 1000BASE-T, and 155 Mb/s ATM.
- C. The contractor shall provide a warranty on the physical installation of not less than one year at no cost to the owner. Information, with regard to the proper procedures to follow if needed should be included with the warranty. They should include but not be limited to; contact name, contact telephone number, project reference, anticipated response time.

1.12 FINAL ACCEPTANCE & SYSTEM CERTIFICATION

- A. Final Acceptance of the implemented cable system solution will be provided in writing from the Owner / Owner's Representative. It will be issued upon successful completion of the installation, including but not limited to, final inspections, receipt of the successful test results and as-built documentation, and successful performance of the cabling system for a thirty-day period. Upon successful completion of the installation and subsequent inspection, the Owner/Owner's Representative shall be provided with a numbered certificate, from the Manufacturer of the installed system solution. This Extended Product Warranty shall be provided within sixty days of the completion of the project. Final payment will not be made until such warranty / numbered certificate is received.

PART 2 – PRODUCTS

2.1 EQUIPMENT COMPATIBILITY REQUIREMENTS

- A. General: While individual items of equipment may meet the equipment specifications, and in fact, meet the system specifications when electrically associated with other equipment, the total system shall be designed so that the combination of equipment actually employed does not produce effects such as signal distortions, noise pulses, data noise, transients, phantom calls or other interference's.

2.2 WORK AREA OUTLETS

- A. Work area cables shall each be terminated at their designated work area location in the connector types described in the subsections below. Included are modular telecommunication jacks. These connector assemblies shall snap into a faceplate.
- B. The Telecommunications Outlet Assembly shall accommodate the number of jacks as noted on the project drawings. Additional accommodations for specific locations as noted in the plans for optical fiber and/or additional copper cables shall be provided as necessary. A blank filler module will be installed when extra ports are not used.
- C. The same orientation and positioning of jacks and connectors shall be utilized throughout the installation. Please refer to typical outlet configuration on project drawings prior to installation.
- D. Printed labels shall be permanent and compliant with ANSI/TIA/EIA-606-B standard specifications. Labels shall be machine printed. Hand written labels shall not be accepted.

2.4 HORIZONTAL DISTRIBUTION CABLE

- A. All horizontal cabling must be plenum rated Category 6. The horizontal cable shall be terminated on Category 6 modular patch panels as specified on the drawings. The horizontal cable must pass all Category 6 testing parameters upon completion of installation and termination.

2.5 COAX CABLE

- A. Plenum rated coax cable shall be installed to provide for video service within the facility. It shall run from the respective Telecommunications Room to specific locations as indicated on the project drawings.

2.6 FACEPLATES AND CONNECTING MODULES

- A. Faceplates: Flush mount faceplates, style designed to accept snap-in place connecting modules in jack configurations as specified within the contract documents. Faceplates shall have two recessed labeling areas with clear plastic lens cover for system or station identification. Each jack shall be labeled with a color coded embossed tab appliqué differentiating between data, telephone and spare jacks. Individual cable ends shall be labeled to correspond to the actual jack location as well as termination location in the telecommunications room and subsequent floor distribution centers.
- B. Voice / Data Jacks shall be 8-position modular jacks and shall meet or exceed Category 6 performance standards as defined by the references in this document. All pair combinations must be considered, with the worst-case measurement being the basis for compliance. Modular jack performance shall be third-party verified by a nationally recognized independent testing laboratory.
 - 1. The modular jack shall be backwards compatible to Category 3, 5, 5e and 6.
 - 2. The modular jack shall be center tuned to category 6 test specifications.
- C. Video Jacks/ Splitters / Coax Connectors
 - 1. Video jacks shall be "F" connectors and shall be installed in locations per the project drawing.
 - 2. Video Splitters shall be a passive one (1) input to eight (8) output, 1 GHz device. It shall be mounted as shown in construction drawings.

2.7 MODULAR PATCH PANELS

- A. Modular Category 6 performance rated patch panels shall be used for the horizontal to terminate on. The panels shall be T568A standard, not high density, and use a standard 110-impact tool for termination.
- B. Modular patch panel shall be used to terminate the backbone voice cable on. The panel shall be 8 position,

2.8 WIRE MANAGEMENT PANELS

- A. Cable management shall be provided above and below every 48 ports of patch / distribution panels. The wire management panels shall provide horizontal organization of patch cables on the rack.
- B. Cable management shall be provided for the vertical organization of patch / distribution panels.

2.9 PATCH CABLES

- A. Category 6 patch cables shall be provided and installed as part of the project. The owner shall provide port assignments prior to completion of the project. Patch cables shall be provided in the types and quantities indicated on the contract drawings.
- B. Fiber optic patch cables shall be provided and installed as part of the project. The owner shall provide port assignments prior to completion of the project. The fiber optic patch cables shall be provided in the types and quantities indicated on the contract drawings.

2.10 FIBER CONNECTORS

- A. Fiber cables shall be terminated using fusion spiced pigtailed with LC-APC Type connectors. The connector shall be compliant TIA/EIA 604-3 and have a ceramic ferrule.

2.11 INSIDE BACKBONE CABLE

- A. Copper Horizontal Backbone Cable; Unshielded, Category 3, multi-pair copper cables shall be used. The cable shall support voice, some data and video applications. The bending radius and pulling strength requirements of all backbone cables shall be observed during handling and installation. The multi-pair copper cable shall be a plenum rated cable between the building entrance terminal and the 110 Patch Panels.
- B. Plenum rated fiber shall be placed as indicated on construction drawings. It shall have a tensile strength to 300 lbs. for installation. It shall have an all dielectric design. It shall be terminated in a fiber panels as indicated on construction drawings.

2.12 RACKS

- A. All racks and wire management shall be as listed in the hardware schedule. The equipment rack shall provide vertical cable management and support for the patch cords at the front of the rack and wire management, support, and protection for the horizontal cables inside the legs of the rack. Waterfall cable management shall be provided at the top of the rack for patch cords and for horizontal cables entering the rack channels for protection and to maintain proper bend radius and cable support. Wire management shall also be mounted above each patch panel and/or piece of equipment on the rack. The rack shall include mounting brackets for cable tray ladder rack to mount to the top of the rack. Velcro cable ties shall be provided inside the rack channels to support the horizontal cable. Rack shall be black in color to match the patch panels and cable management.
- B. Free-Standing Rack

1. Free-standing rack shall:

- a. provide the necessary strain relief, bend radius and cable routing for proper installation of high performance cross connect products, meeting all specifications of ANSI/TIA/EIA-568-B.
- b. have top cable trough with waterfall and built in patch/horizontal cable distribution separator.
- c. have EIA hole pattern on front and rear.
- d. be available with a 6.5" (165 mm) channel depth.
- e. be available with hook and loop straps for securing bulk cables inside the vertical U-channels.
- f. assemble as 19" (483 mm) with no additional hardware.
- g. be available with three styles of vertical patch cord management: interbay with latches, cable management rings, or fingerduct with covers.
- h. provide floor and ceiling access for cable management and distribution.
- i. provide pre-drilled base for floor attachment of rack.
- j. be available in standard color of black.
- k. be manufactured by an ISO 9001 registered company.

2.13 GROUNDING AND BONDING

- A. The facility shall be equipped with a Telecommunications Bonding Backbone (TBB). This backbone shall be used to ground all telecommunications cable shields, equipment, racks, cabinets, raceways, and other associated hardware that has the potential to act as a current carrying conductor. The TBB shall be installed independent of the building's electrical and building ground and shall be designed in accordance with the recommendations contained in the ANSI/TIA/EIA-607 Telecommunications Bonding and Grounding Standard.
- B. The main entrance facility/equipment room shall be equipped with a telecommunications main grounding bus bar (TMGB). Each telecommunications room shall be provided with a telecommunications ground bus bar (TGB). The TMGB shall be connected to the building electrical entrance grounding facility. The intent of this system is to provide a grounding system that is equal in potential to the building electrical ground system. Therefore, ground loop current potential is minimized between telecommunications equipment and the electrical system to which it is attached.
- C. All racks, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, etc. entering or residing in the TR or ER shall be grounded to the respective TGB or TMGB using a minimum #6 AWG stranded copper bonding conductor and compression connectors.
- D. All wires used for telecommunications grounding purposes shall be identified with a green insulation. Non-insulated wires shall be identified at each termination point with a wrap of green tape. All cables and bus bars shall be identified and labeled in accordance with the System Documentation Section of this specification.

2.14 FIRESTOP

- A. A firestop system is comprised of the item or items penetrating the fire rated structure, the opening in the structure and the materials and assembly of the materials used to seal the penetrated structure. Firestop systems comprise an effective block for fire, smoke, heat, vapor and pressurized water stream.
- B. All penetrations through fire-rated building structures (walls and floors) shall be sealed with an appropriate firestop system. This requirement applies to through penetrations (complete

penetration) and membrane penetrations (through one side of a hollow fire rated structure). Any penetrating item i.e., riser slots and sleeves, cables, conduit, cable tray, and raceways, etc. shall be properly fire stopped.

- C. Fire stop systems shall be UL Classified to ASTM E814 (UL 1479).

2.15 CEILING CABLE RACEWAY SYSTEM

- A. Ceiling Space: Contractor will allow for a minimum of 3" of clear vertical space above conduits and cables, and 12" of clear vertical space above the tray or raceway for overhead ceiling tray or raceway systems. Other building components (lighting fixtures, structural supports, air ducts) will not restrict access to the cable trays or raceways.
- B. Restrictions: Cabling within ceilings used as a plenum for environmental air must conform to the requirements of National Codes and Regulations and NEC, Section 300-22.
- C. Ceiling raceways, cable trays and cabling will be suspended from or attached to the structural ceiling or walls with hardware or other installation aids specifically designed to support their weight.
- D. Pathways must have adequate support to withstand pulling cables and will be installed with at least 6" of clear vertical space above the ceiling tiles and support channels to ensure accessibility.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Examine the areas to receive the Work and the conditions under which the Work is to be performed. Remedy conditions detrimental to the proper and timely completion of the Work. Do not proceed until unsatisfactory conditions have been corrected.

3.2 WORK AREA OUTLETS

- A. Cables shall be coiled in the in-wall or surface-mount boxes if adequate space is present to house the cable coil without exceeding the manufacturers bend radius. In hollow wall installations where box-eliminators are used, excess wire can be stored in the wall. No more than 12" of UTP and 36" of fiber slack shall be stored in an "in-wall" box, modular furniture raceway, or insulated walls. Excess slack shall be loosely coiled and stored in the ceiling above each drop location when there is not enough space present in the outlet box to store slack cable.
- B. Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/TIA/EIA-568-B.1 document, manufacturer's recommendations, BICSI and best industry practices.
- C. Pair untwist at the termination shall not exceed 12 mm (one-half inch).
- D. Bend radius of the horizontal cable shall not be less than 4 times the outside diameter of the cable.
- E. The cable jacket shall be maintained to within 25mm (one inch) of the termination point.

- F. The work area (WA) outlet should be located near a power outlet and installed at the same height.
- G. Distribution hardware shall be securely mounted in a manner that shall provide access to the connections for testing and allow sufficient cable room for access to panels without disturbing the cables.
- H. The maximum length on all horizontal distribution cables will be no more than 295'.

3.3 HORIZONTAL DISTRIBUTION CABLE INSTALLATION

- A. Cable shall be installed in accordance with recommendations from the manufacturer, BICSI and best industry practices. Each shall be permanently attached to the building structure and held firmly in place. Conceal fasteners used for attachment of boxes to supporting structures and surfaces wherever possible.
- B. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit.
- C. Cable raceways shall not be filled greater than the ANSI/TIA/EIA-569-A maximum fill for the particular raceway type or 40%.
- D. Cables shall be installed in continuous lengths from origin to destination (no splices) except for transition points, or consolidation points as noted on the project drawings. Additional splices, transition points or consolidation points must be approved in writing by the Owner / Owner's Representative.
- E. Where transition points, or consolidation points are allowed, they shall be located in accessible locations and housed in an enclosure intended and suitable for the purpose.
- F. In areas where cable tray/wire baskets are not used a J-hook or trapeze system shall be used to support cable bundles. All horizontal cables shall be supported at a maximum of 48 inch intervals. At no point shall cable(s) rest on acoustic ceiling grids or panels or any other type of ceiling. They also shall not rest on tops of walls, or duct work.
- G. Horizontal distribution cables shall be bundled in groups of no more than 50 cables. Cable bundle quantities in excess of 50 cables may cause deformation of the bottom cables within the bundle and degrade cable performance.
- H. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.
- I. Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, the contractor shall install appropriate carriers to support the cabling.
- J. Any cable damaged or exceeding recommended installation or test parameters during installation shall be replaced by the contractor before final acceptance at no cost to the Owner.
- K. Cables shall be identified by a self-adhesive label in accordance with the System Documentation Section of this specification and ANSI/TIA/EIA-606-A. The cable label shall be applied to the cable at each end behind the faceplate and patch panel on a section of cable that can be accessed by removing the cover plate (6" back from termination point).

Brady LAT-18-361-1 or submit sample to Contracting Officer for approval prior to installation.

- L. Unshielded twisted pair cable shall be installed so that there are no bends smaller than four times the outside diameter of the cable at any point in the run and at the termination field. The cable's minimum bend radius shall not be exceeded.
- M. Pulling tension on 4-pair UTP cables shall not exceed 25-lb. for a four-pair UTP cable. The cables maximum pulling tension shall not be exceeded.
- N. The installation of cable shall conform to the following clearances:
 - 1. At 5 inches (127 millimeters) from power lines carrying 2KVA or less.
 - 2. At least 12 inches (305 millimeters) from power lines carrying from 2 to 5 KVA.
 - 3. At least 36 inches (915 millimeters) from power lines carrying more than 5 KVA.
 - 4. At least 2 inches (305 millimeters) from all fluorescent lights and other sources of electromagnetic interference such as electric motors, HVAC equipment, arc welders, intercoms, etc.

3.4 HORIZONTAL CROSS CONNECT INSTALLATION

- A. Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/TIA/EIA-568-B standard, manufacturer's and BICSI recommendations, and best industry practices.
- B. Cable pair untwist at the termination shall not exceed 13 mm (0.5 inch).
- C. Bend radius of the cable in the termination area shall not exceed 4 times the outside diameter of the cable.
- D. Cables shall be neatly bundled and dressed to their respective panels or blocks. Each panel or block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.
- E. The cable jacket shall be maintained as close as possible to the termination point.
- F. Each cable shall be clearly labeled on the cable jacket behind the patch panel at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

3.5 COPPER TERMINATION HARDWARE

- A. Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/TIA/EIA-568-B standard, manufacturer's recommendations, BICSI and best industry practice.
- B. Cable pair untwist at the termination shall not exceed 12 mm (one-half inch).
- C. Bend radius of the cable in the termination area shall not exceed 4 times the outside diameter of the cable. Bend radius of cables shall not be exceeded at any time.
- D. Cables shall be neatly bundled and dressed to their respective panels or blocks. Each panel or block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.
- E. The cable jacket shall be maintained to within 25 mm (one inch) of the termination point.

- F. Each cable shall be clearly labeled on the cable jacket behind the patch panel at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

3.6 FIBER TERMINATION HARDWARE

- A. Fiber slack shall be neatly coiled within the fiber splice tray or enclosure. No slack loops shall be allowed external to the fiber panel.
- B. Each cable shall be individually attached to the respective splice enclosure by mechanical means. The cables strength member shall be securely attached the cable strain relief bracket in the enclosure.
- C. Each fiber bundle shall be stripped upon entering the splice tray and the individual fibers routed in the splice tray.
- D. Each cable shall be clearly labeled at the entrance to the splice enclosure. Cables labeled within the bundle shall not be acceptable.
- E. A maximum of 12 strands of fiber shall be spliced in each tray
- F. All spare strands shall be installed into spare splice trays.

3.7 RACKS AND WALL MOUNTED TERMINATION FIELDS

- A. Racks shall be securely attached to the concrete floor using a minimum 3/8" hardware or as required by local codes.
- B. Racks shall be placed as shown on construction drawings. They shall be aligned with the existing racks.
- C. All racks shall be grounded to the telecommunications ground bus bar in accordance with ANSI/TIA/EIA-607 standard, and shall be installed in accordance with best industry practice.
- D. Rack mount screws not used for installing patch panels and other hardware shall be bagged and left with the rack upon completion of the installation.
- E. Wall mounted termination block fields shall be mounted on void free plywood as shown in the construction drawings. The plywood shall be mounted vertically 12" above the finished floor. The plywood shall be painted with two coats of white fire retardant paint.

3.8 FIRESTOP SYSTEM

- A. All fire stop systems shall be installed in accordance with the manufacturer's recommendations and shall be completely installed and available for inspection by the local inspection authorities before cable system acceptance.

3.9 GROUNDING SYSTEM

- A. The TBB shall adhere to the recommendations of the ANSI/TIA/EIA-607 standard, and shall be installed in accordance with best industry practice.
- B. A licensed electrical contractor shall perform installation and termination of the main bonding conductor to the building service entrance ground.

3.10 IDENTIFICATION AND LABELING

- A. The Owner/Owner's Representative will negotiate an appropriate labeling scheme with the successful contractor. At a minimum, the labeling system shall clearly identify all components of the system: racks, cables, panels and outlets. The labeling system shall designate the cables origin and destination and a unique identifier for the cable within the system. Racks and patch panels shall be labeled to identify the location within the cable system infrastructure. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme. Labeling shall follow the guidelines of ANSI/TIA/EIA-606-A.
- B. All label printing will be machine generated. Labels will be used on cable jackets, appropriately sized to the OD of the cable, and placed within view at the termination point on each end. Outlet, patch panel and wiring block labels shall be installed on, or in, the space provided on the device.
- C. Contractor shall install communication jacks and wall plates with manufacturer provided labeling for each individual jack and wall plate. Each jack shall be labeled as shown on drawings. The labeling shall differentiate between jacks, while each wall plate shall be provided with labeling to differentiate wall jack locations. Cable ends to be terminated at communications rack shall be correspondingly labeled on the patch panel to the wall jacks that they serve. Contractor shall coordinate labeling designations with Owner. It should however represent the room number/outlet number/ jack designation.

3.11 TESTING AND ACCEPTANCE

A. GENERAL

- 1. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements of ANSI/TIA/EIA-568-B. All pairs of each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors in all cables installed at no cost to the Owner.
- 2. All cables shall be tested in accordance with this document, the ANSI/TIA/EIA standards, and the Manufacturer's Certification Program Information Manual, BICSI and best industry practice. If any of these are in conflict, the Contractor shall bring any discrepancies to the attention of the Owner / Owner's Representative for clarification and resolution.

B. COPPER CABLE TESTING

- 1. All twisted-pair copper cable links shall be tested for continuity, pair reversals, shorts, opens and performance as indicated below. Additional testing is required to verify Category performance. Horizontal cabling shall be tested using a Level III test unit for category 6-performance compliance as specified in ANSI/TIA/EIA-568-B.2-1.
- 2. Continuity - Each pair of each installed cable shall be tested using a test unit that shows opens, shorts, polarity and pair-reversals, crossed pairs and split pairs. Shielded/screened cables shall be tested with a device that verifies shield continuity in addition to the above stated tests. The test shall be recorded as pass/fail as indicated by the test unit in accordance with the manufacturers' recommended procedures, and referenced to the appropriate cable identification number and circuit or pair number.

Any faults in the wiring shall be corrected and/or replaced and re-tested before final acceptance.

3. Length - Each installed cable link shall be tested for installed length using a TDR type device. The cables shall be tested from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length shall conform to the maximum distances set forth in the ANSI/TIA/EIA-568-B Standard. Cable lengths shall be recorded, referencing the cable identification number and circuit or pair number. For multi-pair cables, the longest pair length shall be recorded as the length for the cable.

C. Category 6 Performance - Follow the Standards requirements established in:

1. ANSI/TIA/EIA-568-B .1, B.2-1
2. A Level III test unit is required to verify category 6 performance. The basic tests required are:
 - a. Wire Map
 - b. Length
 - c. Attenuation
 - d. NEXT (Near end crosstalk)
 - e. Return Loss
 - f. ELFEXT Loss
 - g. Propagation Delay
 - h. Delay skew
 - i. PSNEXT (Power sum near-end crosstalk loss)
 - j. PSELFEXT (Power sum equal level far-end crosstalk loss)

3.12 SYSTEM DOCUMENTATION

- A. Upon completion of the installation, the telecommunications contractor shall provide three (3) full documentation sets to the Owner / Owner's Representative for approval. Documentation shall include the items detailed in the sub-sections below.
- B. Documentation shall be submitted within ten (10) working days of the completion of each testing phase (e.g. subsystem, cable type, area, floor, etc.). This is inclusive of all test results and draft annotated drawings. Draft drawings may include annotations done by hand. Machine generated (final) copies of all drawings shall be submitted within 30 working days of the completion of each testing phase. The telecommunications contractor shall provide copies of the original test results to the Owner / Owner's Representative.
- C. The Owner / Owner's Representative may request that a 10% random field re-test be conducted on the cable system, at no additional cost, to verify documented findings. Tests shall be a repeat of those defined above. If findings contradict the documentation submitted by the telecommunications contractor, additional testing can be requested to the extent determined necessary by the Owner / Owner's Representative, including a 100% re-test. This re-test shall be at no additional cost to the Owner.

3.13 TEST RESULTS

- A. Test documentation shall be provided to the Owner / Owner's Representative within three weeks after the completion of the project. The telecommunications contractor shall provide one set of documentation, printed on paper and two copies on compact disk. The disk shall be clearly marked on the outside front cover with the words "Project Test Documentation", the project name, and the date of completion (month and year). The results shall include a

record of test frequencies, cable type, conductor pair and cable (or outlet) I.D., measurement direction, reference setup, and crew member name(s). The test equipment name, manufacturer, model number, serial number, software version and last calibration date will also be provided at the end of the document. Unless the manufacturer specifies a more frequent calibration cycle, an annual calibration cycle is mandatory on all test equipment used for this installation. The test document shall detail the test method used and the specific settings of the equipment during the test as well as the software version being used in the field test equipment.

- B. The field test equipment shall meet the requirements of ANSI/TIA/EIA-568-B including applicable TSB's and amendments. The appropriate Level III tester shall be used to verify Category 6 cabling systems.
- C. Printouts generated for each cable by the wire (or fiber) test instrument shall be submitted as part of the documentation package. The telecommunications contractor must furnish this information in electronic form (CD-ROM) and print out on paper.
- D. When repairs and re-tests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be documented.

3.14 AS-BUILT DRAWINGS

- A. The drawings are to include cable routes and outlet locations. Outlet locations shall be identified by their sequential number as defined elsewhere in this document. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided. The Owner will provide floor plans in paper and electronic (DWG, AutoCAD 2010) formats on which as-built construction information can be added. These documents will be modified accordingly by the telecommunications contractor to denote as-built information as defined above and returned to the Owner/Owner's Representative.
- B. The Contractors shall annotate the base drawings and return a hard copy (same plot size as originals) and compact disk (AutoCAD 2010) form.

END OF SECTION 271000

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SECTION 283111 – FIRE ALARM SYSTEM

SECTION 283150 – MASS NOTIFICATION SYSTEM

SECTION 283111 - FIRE ALARM SYSTEM

PART 1 - GENERAL

1.2 SCOPE

- A. The work covered by this Section consists of furnishing all labor, materials, tools, equipment, services, coordination, and supervision required to install, test, and place in service a Monaco conventional fire alarm system for the Missouri Air National Guard.
- B. All system operations shall comply with the complete Unified Facilities Criteria (UFC) 3-600-01, dated 1 March 2013 and Air National Guard Design Policy – ANG ETL 01-1-1 dated March 2004. If the event that discrepancies arise between these two documents, the more stringent requirement will apply. All requirements of these documents take precedence over any requirement of these specifications. The fire alarm sections only of these two documents are included at the end of this section for reference purposes.
- C. All work performed and all materials furnished shall meet the requirements of the applicable current standards of the National Fire Protection Association (NFPA): 72-2010; Underwriters' Laboratories, Inc. (UL); Americans with Disabilities Act and other federal, state, and local codes and ordinances except as otherwise indicated on the drawings or specified herein.
- D. After entering into the contract, the Contractor shall be held responsible for the completion of all work necessary for a complete and approved installation without extra expense to the Owner or Contracting Officer. The Contractor shall prepare any supplementary detailed diagrams or drawings, which may be required by the state authority or local Authority Having Jurisdiction (AHJ).
- E. Any deviations from the requirements of this specification must be acknowledged in writing with the supplier's bid offer.

1.2 APPLICABLE REFERENCES

- A. National Fire Protection Association (NFPA):
 - 1. No. 70 - 2011, National Electric Code (NEC)
 - 2. No. 72 - 2010, National Fire Alarm Code
 - 3. No. 1221 – 2010, Standard for Installation, Maintenance & Use of Emergency Services Communications Systems
- B. Department of Defense:
 - 1. UFC 4-021-01 (19 December 2002) Design and O & M: Mass Notification Systems
 - 2. UFC 03-601-01 Facility Planning and Design Guide
 - 3. UFC 04-04-010-01 Design and O & M: Mass Notification System
 - 4. ANG-ETL-01-1-1 Revised March 2004 (attached)
- C. Underwriters Laboratories Inc. (UL):
 - 1. No. 50 - Cabinets and Boxes
 - 2. No. 268 - Smoke Detectors for Fire Protective Signaling Systems
 - 3. No. 864 - Control Units for Fire Protective Signaling Systems
 - 4. No. 268A - Smoke Detectors for Duct Applications.
 - 5. No. 521 - Heat Detectors for Fire Protective Signaling Systems.
 - 6. No. 464 - Audible Signaling Appliances.
 - 7. No. 38 - Manually Actuated Signaling Boxes.
 - 8. No. 1481 - Power supplies for Fire Protective Signaling Systems.
 - 9. No. 1971 - Visual Notification Appliances.

1.3 SYSTEM DESCRIPTION

- A. A complete operating conventional fire alarm, detection, control, and monitoring system shall be installed throughout the addition of the 139th Missouri Air National Guard – Security Forces Admin and Storage Building as detailed in the Air National Guard Design Policy – ANG ETL 01-1-1 dated March 2004, as specified herein and as shown on the drawings.
 - 1. The system shall include, but not be limited to: alarm notification appliances and alarm indicating devices, raceway, wire and all accessories required to furnish a complete and operational system.
- B. The 139th Missouri Air National Guard – Security Forces Admin and Storage Building shall be served by one dedicated conventional fire alarm control panel.
- C. Audible Alarm Indication: Horns (Temporal Tone per NFPA 72)
- D. System Wiring: System wiring shall be Class A Style D for initiating circuits and Class A Style Z for notification appliance circuits.
- E. Means of lightning suppression shall be provided at all locations where fire alarm circuits leave the protected buildings interior.
- F. The sequence of operations for the fire alarm system shall be as described on the drawings.

1.4 SUBMITTALS

- A. General: Contractor shall submit the following:
 - 1. Submittals and shop drawings shall be approved by the Contracting Officer prior to ordering equipment or commencing system installation.
 - 2. Operation and Maintenance manuals and as-built drawings shall be provided in electronic format and hard copy at the completion of the project.
 - 3. Complete and comprehensive submittals in full accordance with the Unified Facilities Criteria (UFC) 3-600-01, dated 26 September 2006 and Air National Guard Design Policy – ANG ETL 01-1-1 dated March 2004, NFPA 72 and these specifications.
 - 4. Nine complete sets of submittals. Partial submittals shall not be accepted.
- B. Approval of submittals shall not relieve Contractor of conformance with the Unified Facilities Criteria (UFC) 3-600-01 dated 26 September 2006, Air National Guard Design Policy – ANG ETL 01-1-1 dated March 2004, the contract drawings, specifications, and applicable codes and standards. The following are required submittals:
 - 1. Shop Drawings: The shop drawings shall, as a minimum, include the equipment layout, device arrangement, output ratings of the audible and visual devices, complete point-to-point wiring diagrams, conduit/wiring layouts, riser diagram, battery calculations, voltage drop calculations, sequence of operations and internal panel diagrams. The shop drawings shall be stamped by a qualified fire protection engineer as detailed in the Unified Facilities Criteria (UFC) 3-600-01, dated 26 September 2006 and Air National Guard Design Policy – ANG ETL 01-1-1 dated March 2004.
 - 2. Battery and Voltage Drop Calculations: Provide complete calculations for battery capacity for alarm/supervisory modes and current drain/load consumption of all circuits while in alarm condition. Provide complete calculations for voltage drop on all notification appliance circuits and verify the system will provide the proper voltage to supply the notification appliances. The battery and voltage drop calculations shall be provided with the shop drawings and updated and submitted with the as-built drawings. The battery and voltage drop calculations shall be stamped by a qualified fire protection engineer as detailed in the Unified Facilities Criteria (UFC) 3-600-01, dated 26 September 2006 and Air National Guard Design Policy – ANG ETL 01-1-1 dated March 2004.

3. Product Certifications: Provide technical data sheets by the manufacturers of all fire alarm and electrical equipment proposed for installation. Certifications shall clearly indicate products comply with the referenced standards and these specifications. All fire alarm equipment shall be submitted. As a minimum, the following electrical equipment shall be submitted: wire and cables; raceway, i.e. conduit; back boxes for devices; pull/junction boxes; automatic label maker; terminal blocks used for splices; and conduit connectors. All Certifications shall be clearly indexed and marked to indicate the proposed items of equipment to be furnished. Item shall be submitted with the Shop Drawings.
4. Operation & Maintenance (O&M) Manuals: O&M Manual shall be neatly organized in 8 ½ x 11 three-ring hard cover binder in typed format with tabbed fly sheets and index. Contents shall include: Cover with Contractor and Project information; complete instructions regarding operations and maintenance of all equipment; test report/address description list; final complete fire alarm system program report reflecting final conditions (shall include all operating instructions written for fire alarm programming); copy of all guarantees and warranties issued, and; manufacturers' bulletins, cut sheets, and descriptive data, where pertinent, clearly indicating the precise items included in this installation, and deleting, or otherwise clearly indicating, all manufacturers' data with which this installation is not concerned. Preliminary Submittal to be submitted with Shop Drawings. Final Submittal to be submitted with Record/As-Built Drawings.
5. Record/As-Built Drawings: Accurate ($\pm 1'-0"$) As-Built drawings reflecting the as-built conditions shall be provided to the Contracting Officer prior to acceptance testing. As-Built drawings shall be furnished to the Contracting Officer on electronic media in AutoCAD 2000 compatible format and also a complete set of reproducible tracings of 24" x 36" scale (minimum) showing the as built layout of all conduit systems and/or wire routing and all fire alarm equipment, complete riser diagrams showing all devices, and accurate panel diagrams showing all field wiring terminations and labels. The record/as-built drawings shall be stamped by a qualified fire protection engineer as detailed in the Unified Facilities Criteria (UFC) 3-600-01, dated 26 September 2006 and Air National Guard Design Policy – ANG ETL 01-1-1 dated March 2004.

1.5 QUALITY ASSURANCE

- A. All equipment furnished shall be new and the latest state-of-the-art products of a single manufacturer engaged in the manufacturing and sale of fire detection devices for over ten years.
 1. The Contractor shall contract with a single source for supplying job materials, services, and programming, including final inspection/test services for the fire alarm system.
- B. Installer Qualifications: Contractor shall complete the following:
 1. Demonstrate in writing for advance approval by the Contracting Officer, 5 years of fire alarm installation experience and five years of substantial experience in Monaco fire alarm system installation projects.
 2. Provide in writing for advance consideration at least five local references for similar Monaco fire alarm system installation projects.
 3. Engage an experienced factory-authorized service representative to oversee the work of this Section and the testing of the system. The factory-authorized service representative shall be available during the entire construction phase, including testing. The Contractor shall provide a copy of the factory certificate of the factory-authorized service representative for this project.
 4. The installing company shall employ NICET (minimum Level II Fire Alarm Technology) technicians on site to guide the final check-out and to ensure the systems integrity.
 5. All materials and equipment furnished and installed under this Section shall be new and currently listed by UL, Inc., or approved by FM Engineering Corporation, except as otherwise specified herein

1.6 MAINTENANCE AND WARRANTY SERVICE

- A. All work performed, all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) years from the date of formal acceptance. The full cost of all service/diagnostics, maintenance, labor and materials, reprogramming, retesting, pickup and delivery required to correct any defect during the two year period shall be included in the bid submittal. Replacement parts shall be the original manufacturer's replacement parts, components, and supplies. Any required testing and maintenance cost for this maintenance and testing of the system shall be at no extra cost to the Owner and shall be included as part of this contract.
- B. The Warranty shall also include all service, maintenance and testing as required by NFPA 72, Chapter 10 for the year one period after the date of formal system acceptance.
- C. Warranty service shall be performed within 24 hours of notification during normal working hours (Monday through Friday, 8:00 a.m. to 5:00 p.m., excluding holidays) and within 48 hours of notification during all other times.

PART 2 - PRODUCTS

2.1 All equipment and products furnished shall be UL listed or FM approved and labeled, and connection shall comply with NEMA construction standards.

2.2 DEVICES

- A. Manual Pull Stations: Double-action type, fabricated of metal or plastic, and finished in red with molded, raised-letter operating instructions of contrasting color. Stations requiring the breaking of a glass panel are not acceptable. Stations requiring the breaking of a concealed glass rod shall not be provided.
 - 1. Station Reset: Key- or wrench-operated, double-pole, double-throw, switch rated for the voltage and current at which it operates. Stations shall have screw terminals for connections.
- B. Smoke/Heat Detectors: Detectors shall be photoelectric type combination smoke/heat. The smoke detectors shall comply with UL 268, "Smoke Detectors for Fire Protective Signaling Systems" and shall include the following features:
 - 1. Factory Nameplate: Serial number and type identification.
 - 2. Combination smoke/heat detectors.
 - 3. Operating Voltage: 24 VDC, nominal.
 - 4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
 - 5. Visual Indicator: Each sensor base shall contain an LED that will flash as an indication of proper sensor operation. Sensors that do not provide a visible indication of an abnormal condition at the sensor location shall not be acceptable.
- C. Duct Detectors: For duct mounted applications provide detector housing with auxiliary relay and sampling tubes as required.
 - 1. For maintenance purposes, it shall be possible to clean the duct housing sampling tubes by accessing them through the duct housing front cover.
 - 2. To minimize false alarms, voltage and RF suppression techniques shall be employed as-well-as a smoke signal verification circuit and an insect screen.
 - 3. Auxiliary relays and/or remote LED alarm indicators and key operated test stations shall be installed where indicated.

2.3 FIRE ALARM AUDIBLE/VISUALS AND VISUALS AND AUDIBLES ONLY

- A. General: Visual and audio/visual indicating appliances shall be comprised of a Xenon flashtube and be entirely solid state. These devices shall be UL listed and shall be a minimum 75 cd or as indicated on the drawings. The visual appliance shall have a 1 HZ flash rate. The light unit shall be of ABS polycarbonate and the lens of high grade, optical quality LEXAN.
- B. All visual appliances shall be in compliance with ADA and as indicated on the drawings.

- C. Audible appliances shall provide a minimum 90 dBA sound level at 10 feet with a 1kHz signal.

2.4 FIRE ALARM ELECTRICAL IDENTIFICATION

- A. All electrical identification shall comply with the requirements found in the Unified Facilities Criteria (UFC) 3-600-01, dated 26 September 2006 and Air National Guard Design Policy – ANG ETL 01-1-1 dated March 2004.

2.5 WIRE

- A. All wire shall comply with the requirements found in the Unified Facilities Criteria (UFC) 3-600-01, dated 26 September 2006 and Air National Guard Design Policy – ANG ETL 01-1-1 dated March 2004
- B. All wiring shall be THHN or TFFN stranded with crimp on terminal ends affixed.
- C. Wire shall be in strict accordance with manufacturer's published installation recommendations, Article 760 of NFPA 70 (2008 Edition), the drawings, and these specifications.
- D. Splicing of wire shall not be permitted. All wiring is to be continuous from panel to device and device-to-device. Terminal blocks shall be used only where absolutely necessary.
- E. The use of wire nuts is prohibited.
- F. All wiring shall be color-coded and fully identified. Provide the proposed color code with the submittal documentation.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. System installation shall be in full accordance with the requirements found in the Unified Facilities Criteria (UFC) 3-600-01, dated 26 September 2006 and Air National Guard Design Policy – ANG ETL 01-1-1 dated March 2004, drawings, specifications, NFPA Standards, and the manufacturer's published recommendations.

3.2 EQUIPMENT INSTALLATION

- A. The FACP shall be semi-recessed with the top of the cabinet not more than five feet six inches above the finished floor. Control and other panels shall be mounted with sufficient clearance for observation and testing.
- B. Penetrations for cables, cable trays, conduits, pipes, tubes, wires, and similar items to accommodate electrical and communications systems that pass through a wall, floor, or floor/ceiling assembly constructed as a fire barrier shall be protected by a firestop system or device. The firestop system or device shall be tested in accordance with ASTM E-814 or ANSI/UL 1479 at a minimum positive pressure differential of 2.5 N/m² (0.01 in. water column) between the exposed and the unexposed surface of the test assembly.

3.3 WIRING INSTALLATION

- A. All wire shall be installed in accordance with the requirements found in the Unified Facilities Criteria (UFC) 3-600-01, dated 26 September 2006 and Air National Guard Design Policy –.
- B. All detection and alarm wire shall be installed in separate conduits. Each circuits outgoing and return conductors exiting and returning to the control unit, respectively are to be routed separately as required by NFPA 72 and ANG ETL 01-1-1 dated March 2004. The minimum separation of outgoing and return conduits shall be one foot vertically and four feet horizontally. Conduit shall be EMT. Exception would be those locations deemed unsuitable for EMT conduit. In such cases, use Rigid or PVC type conduit. Minimum conduit size shall be ¾". Alarm and supervisory wiring shall be in separate conduits. All conduites and junction boxes shall be identified through color coding and labeling.
- C. All fire detection and alarm system wiring shall be run in minimum ¾" EMT conduit complete and shall be clearly identified.
- D. Minimum fire alarm circuit size shall be as follows:
 - 1. Initiating circuits shall be a minimum of AWG No. 18.

2. Indicating and control circuits shall be AWG No. 14 or larger.
3. Line voltage circuits shall be AWG No. 12 or larger.

E. Wiring Method:

1. All wiring raceways shall be in accordance with NFPA 72 and Article 760 of NFPA 70. Physical raceways for fire alarm circuits shall be a minimum of ¼ inch.
2. System drain wires and conduit grounding shall be properly installed in accordance with the manufacturer's published recommendations.
3. Wiring splices shall be held to an absolute minimum and avoided to the extent possible. If needed, they shall be made only in junction or outlet boxes and shall be connected on terminal blocks with crimp-type connectors.

F. Wiring Within Enclosures:

1. Install conductors parallel with, or at right angles to, the sides and back of the enclosure. Bundle, lace, and train the conductors to terminal points with no excess. Panels shall be completely dressed.
2. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal in accordance with the wiring diagrams of the system.
3. Separate all wiring for initiating devices from all other wiring in FCP enclosure.

G. Grounding shall be provided and connected in strict accordance with manufacturer's installation recommendations.

1. FACP shall be grounded in accordance with NFPA 70. Raceway ground shall not be acceptable.
2. Raceways shall be earth grounded throughout the system.
3. Ground conduits, panels, and devices with green wire.

H. Before any of the devices are connected, each circuit/conductor shall be megger tested except the circuits/conductors intentionally and permanently grounded. Test for resistance to ground. Report readings less than 1 megaohm for evaluation. The megger testing shall be documented and available for review by the Contracting Officer (See Section III.F.3, herein).

I. Protection, Cleaning, and Adjustment

1. Protection from damage and contamination shall be provided for all system components, devices, and equipment during the entire installation and until acceptance testing.
2. Damaged or contaminated devices and/or components shall be replaced before final testing.
3. Final system adjustment, including detector sensitivity, shall be provided before final acceptance testing.

3.4 FIRE ALARM CIRCUIT AND EQUIPMENT IDENTIFICATION:

- A. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated on the approved drawings and address list as applicable.
- B. All Primary Power Circuit Breakers shall be provided with Laminate Signs indicating breaker designation as fire alarm and shall include reference to which fire alarm equipment served.
- C. Equipment Identification: Securely fasten Laminate Signs to all fire alarm control panels, remote power supplies, etc. Signs shall indicate general equipment name, device label and location of fire alarm primary power breaker.

- D. Circuit Identification: Securely fasten Circuit Identification Labels to circuits at all initiating devices, notification appliances, terminal connections and all other splices. Identification markings must correspond with the approved shop drawing circuit designations. Labels must be applied to be legible without moving equipment, labels, circuits, etc.
- E. Install identification products in accordance with the manufacturer's written instructions and requirements of NFPA 70.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Provide services of a pre-approved, factory-authorized service representative to supervise the field assembly and connection of components and the pre-testing, testing, and adjustment of the system. Contractor shall provide written substantiation of the manufacturer's representative's authorization and credentials in advance.
- B. Pre-testing: Upon completing installation of the system, align, adjust, and balance the system and perform complete pre-testing. Determine, through pre-testing, the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed in pre-testing. Replace malfunctioning or damaged items with new equipment, and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of the acceptance test results.
- C. Wiring runs shall be tested for continuity, short circuits and grounds before system is energized. Resistance, current and voltage readings shall be made as work progresses. All circuits shall be tested for shorts and/or leakage with a "megger" (meg-ohm meter). Provide all testing information in a documented report with all values of the testing of each installed piece of wiring and the signature of the testing personnel.
- D. Report of Pretesting: After pretesting is complete, provide a letter and all test reports to the Contracting Officer to certify that the installation is complete and fully operable. Include the names and titles of the witnesses to the preliminary tests.
- E. Final Test Notice: Provide a 30-day minimum notice in writing when the system is ready for final acceptance testing.

3.6 TESTING

- A. All test equipment, instruments, tools and labor required to conduct the system tests shall be provided by the Contractor. As a minimum for conducting the tests, ladders; multimeter; two-way radios; flashlights; smoke generation devices and supplies, and; decibel meter shall be available.
- B. All initiating devices shall be tested and logged for correct operation. Smoke/heat detectors shall be tested for sensitivity using test equipment specifically designed for that purpose. Sensitivity shall be documented on the test report.
- C. Presence of a manufacturer's authorized technical representative shall be required at all acceptance tests and retests.
- D. Acceptance testing shall be in accordance with the procedures outlined in NFPA 72, the manufacturer's recommendations, and the direction of the Contracting Officer and AHJ. In addition, the "Fire Alarm System Checklist for Acceptance" document will be used as part of the acceptance test. This document is provided at the end of this section for reference purposes.
- E. System wiring shall be tested to demonstrate correct system response and correct subsequent system operation in the event of:
 - 1. Open, shorted and grounded addressable signaling circuit.
 - 2. Open, shorted and grounded circuits.
 - 3. Open, shorted and grounded horn circuits.
 - 4. Addressable device removal.
 - 5. Primary power or battery disconnected.
 - 6. Incorrect device at address.

- F. System evacuation alarm indicating appliances shall be demonstrated as follows:
 - 1. All alarm notification appliances operate as programmed.
 - 2. The ambient sound level of each room shall be recorded and the sound level of the audible devices in each room shall be recorded to verify the performance of the system.
- G. System indications shall be demonstrated as follows:
 - 1. Correct message display for each alarm input at the control panel, network workstations and remote alpha-numeric display.
- H. Secondary power capabilities shall be demonstrated as follows:
 - 1. System primary power shall be disconnected for a period of 60 hours. At the end of that period, an alarm condition shall be created and the system shall perform as specified for 5 minutes.
 - 2. System primary power shall be restored for 24 hours and system charging current shall be normal trickle charge for a fully charged battery bank.
 - 3. System battery voltages and charging currents shall be checked at the fire alarm control panel using the codes and display on the LCD.

3.7 FORMAL ACCEPTANCE TESTING

- A. Formal acceptance testing shall be held in the presence of the Contracting Officer, DOAS and Owner, and to their satisfaction. The Contractor shall supply personnel and required auxiliary equipment for this test without additional cost to the Owner.
- B. Report of Pretesting and Acceptance test: After pretesting is complete, provide a letter and all test reports to the Contracting Officer to certify that the installation is complete and fully operable. Include the following:
 - 1. Names and titles of the witnesses to the preliminary tests.
 - 2. Written certification confirming the full compliance with these specifications, the manufacturer's latest recommendations and NFPA 72 (2002 Edition).
 - 3. Written certification confirming the system is free of ground faults, short circuits, and the absence of unwanted voltages between circuit conductors and ground in accordance with the manufacturer's recommendations and NFPA 72 and adequately megger tested including meggar test documentation.
 - 4. Written certification and test results of the complete system checkout procedure in accordance with the manufacturer's published installation recommendations and NFPA 72.
- C. The Contracting Officer shall be provided with two preliminary copies of the record drawings for use during the testing procedure to verify operation as programmed.
- D. In the event of system failure to perform as specified and programmed during the testing procedure, at the discretion of the Owner, or Contracting Officer, the test shall be terminated and rescheduled after the Contractor has made corrections and repeated the pre-testing procedure.
- E. The Owner, or Contracting Officer may elect to require the complete test procedure be performed again if, in their opinion, modifications to the system hardware or software warrant complete retesting.
- F. Operational Test: Acceptance of the system shall also require a demonstration of the stability of the system. This shall be adequately demonstrated if the system operates for a 90 day test period without any unwarranted alarms. Should an unwarranted alarm(s) occur, the Contractor shall readjust or replace the detector(s) or necessary equipment and begin another 90 day test period.

3.8 WRITTEN CERTIFICATIONS AND/OR TEST REPORTS

- A. The following four written certifications and/or test reports shall be submitted by the installation Contractor before final and formal acceptance will be scheduled:
 - 1. Written certification and test results confirming full compliance with these specifications, the manufacturer's latest recommendations, and NFPA 72 (2002 Edition).

2. Written certification and test results confirming the system is free of ground faults, short circuits, and the absence of unwanted voltages between circuit conductors and ground in accordance with the manufacturer's recommendations and NFPA 72 and adequately megger tested.
3. Written report on final system programming configuration.
4. Written certification and test results of the complete system checkout procedure in accordance with the manufacturer's published installation recommendations and NFPA 72 including:
 - (a) A complete list of equipment installation and wiring.
 - (b) Indication that all equipment is properly installed and functioning, and conforms with these Specifications.
 - (c) Technician's name, certification number, and data.
 - (d) After completion of all the tests and adjustments listed above, the Contractor shall submit the following information to the Contracting Officer.
 - (1) Record Drawings
 - (2) Detailed catalog data on all installed system components.
 - (3) Copy of the test report.
 - (4) UL Certificates and/or listing documentation to verify that all equipment is UL Listed for its intended use.
5. Final test and inspection shall be held in the presence of the Contracting Officer and to their satisfaction. The Contractor shall supply personnel and required auxiliary equipment for this test without additional cost.
6. Acceptance of the system shall also require a demonstration of the stability of the system. This shall be adequately demonstrated if the system operates for a 90 day test period without any unwarranted alarms. Should an unwarranted alarm(s) occur, the Contractor shall readjust or replace the detector(s) and begin another 90 day test period. As required by the Contracting Officer, the Contractor shall recheck the devices using the fire test after each readjustment or replacement of devices.
7. If the requirements provided in the paragraph above are not completed within one year after beginning the tests described therein, the Contractor shall replace the system with another acceptable manufacturer and the process repeated until acceptance of the equipment by the Contracting Officer without additional costs.
8. Before final acceptance of the work and the release of the retainage, the Contractor shall deliver three copies of the complete Operating and Maintenance Manual and Record Drawings to the Contracting Officer in hard copy (3 complete sets) and electronic copy in AutoCad, Version 2000 or greater.

3.9 CLEANING AND ADJUSTING

- A. Cleaning: Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean units internally using methods and materials recommended by manufacturer.
- B. Occupancy Adjustments: When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting sound levels and adjusting controls and sensitivities to suit actual occupied conditions. Provide up to three visits at eight hours a piece to the site for this purpose.

3.10 DEMONSTRATION

- A. Provide the services of a factory-authorized service representative to demonstrate the system and train personnel as specified below upon completion of the field installation.
- B. Train personnel in the procedures and schedules involved in operation, troubleshooting, service, and preventive maintenance of the system. Provide a minimum of four hours of on-site training.
- C. Schedule the on-site training with the Owner at least seven days in advance of the training.

The following is the fire alarm section of the Air National Guard Design Policy – ANG ETL 01-1-1 dated March 2004 for reference purposes.

SECTION 15 FIRE PROTECTION

15.1. INTRODUCTION:

15.1.1. Air National Guard fire protection policy is based on the principals of developing an integrated system of balanced protection, which selects options from current technology and which applies the most advantageous design features and systems. These selected features and systems are carefully engineered to reinforce one another and to cover for one another in case of the failure of any one system. The process of achieving that integration, balance and redundancy to attain fire safety objectives is the essence of fire protection engineering, including codes and standards. Air National Guard policy also looks to the designer to develop and select from options which provide the greatest protection and coverage with economy in mind. Additionally, ANG fire protection systems must be designed for maximum reliability, accessibility and maintainability.

15.1.2. Deviations from, additions to, or interpretation of ANG fire protection policy and requirements or codes and standards can only be obtained from the Fire Protection Program Manager at ANG/CE. Deviation from the minimum criteria, where a valid need exists and where an alternate solution involving equivalent concept and sound fire protection engineering is available, may be considered. Any deviation from minimum criteria must have written approval from ANG/CE. The request for deviation approval must include justification, hazard analysis, cost comparison, criteria used and other pertinent data. Should approval be granted, it shall apply only to the specific request under consideration and not to cases with similar circumstances. Lack of funds shall not be considered sufficient justification for deviation below established ANG minimum fire protection standards.

15.1.3. In the event that discrepancies arise between Regulations and Technical Letters, the following general hierarchy shall be used by the A-E.

- UFC's over-ride all other criteria
- Air National Guard Technical letters overrule AF Technical letters and NFPA Standards
- Air Force Technical letters overrule NFPA Standards.

15.1.4. All design projects which involve or impact fire detection and suppression systems for ANG facilities, including renovation, repair, maintenance and new construction require the designer (A-E or in-house) to have on staff or under contract a qualified and experienced Fire Protection Engineer (FPE). It is the FPE's responsibility to develop the specific requirements of the fire protection design and to seal that portion of the design. Although required for all projects, this requirement is particularly important for those involving the design of aircraft hangar fire suppression systems. For the purpose of meeting qualification requirements, a qualified FPE is defined as an individual meeting one of the following conditions:

15.1.4.1. Bachelor of Science or Master of Science degree in fire protection engineering from an accredited university, plus a minimum of 5 years' work experience in fire protection engineering.

15.1.4.2. Professional Engineer (PE) registration by examination, National Council of Examiners for Engineering and Surveys (NCEE) fire protection engineering written examination.

15.1.4.3. Qualification as a GS 804-series FPE.

15.1.4.4. PE registration in a related discipline with a minimum of 5 years' work experience in fire

protection engineering.

15.1.5. All fire protection construction projects and especially those involving the construction of aircraft hangar fire suppression systems, shall have specified requirements that require the contractor (prime or sub) have on staff or under contract a qualified and experienced FPE. This person(s) shall be responsible for performing and overseeing all engineering aspects of the fire protection system construction, including but not limited to, calculations, layout, shop drawings, equipment selection and inspections. In addition, this person(s) shall be responsible for the testing plan and for final commissioning and testing of the system. ANG contract documents (plans and specifications) shall clearly outline the qualification requirements contained herein. For the purpose of meeting qualification requirements, a qualified FPE is defined as an individual meeting one of the following conditions:

15.1.5.1. Bachelor of Science or Master of Science degree in fire protection engineering from an accredited university, plus a minimum of 5 years' work experience in fire protection engineering.

15.1.5.2. Professional Engineer (PE) registration by examination, National Council of Examiners for Engineering and Surveys (NCEE) fire protection engineering written examination.

15.1.5.3. Qualification as a GS 804-series FPE.

15.1.5.4. PE registration in a related discipline with a minimum of 5 years' work experience in fire protection engineering.

15.1.6. Construction of all fire protection systems (suppression and detection) is intended to be of the design-build nature, wherein the construction contractor is given all performance requirements, standards, quality expectations and data necessary for provision of the specified systems. The contractor will use this information to design (hydraulic calculations, shop drawings, equipment selections, equipment location and layout, trade coordination, etc.) and to provide the actual systems. Generally, do not provide sprinkler system piping and head layout design in the construction plans. Do provide comprehensive layout or locations of all required HEF equipment and all detection devices in accordance with standards outlined in this ETL and per NFPA criteria. The outline device locations shall not limit the contractor, who shall be provided full specification as to the standards and requirements for device locations and

15.1.7. Active fire detection and protection systems include automatic detection and notification systems, which tend to activate first, followed by automatic suppression systems, such as sprinklers and/or monitors.

15.1.8. Passive fire protection systems are designed to confine fire and smoke in zones and provide the automatic systems with a manageable fire to act on. Special attention is to be given to the spaces through which occupants will move to safety and the protection of the building's structural integrity.

15.1.9. Specifications shall clearly require contractor submission of all required documents, test results, drawings and manuals. Examples include, but are not limited to, NFPA 13 and 72 forms, as-built drawings, complete O&M manuals, testing and commissioning plans and final reports, etc.. These documents shall be required to be submitted a minimum of 30 days prior to the expected scheduling of Final ANG Acceptance Inspections/Testing and Commissioning. Specifications shall also clearly contain complete requirements for full (all inclusive electrical, mechanical, fire reporting, etc..)system performance testing and commissioning under the supervision of the general contractor. The documents shall be provided as a submittal for review and approval and acceptance inspections/testing will only be scheduled upon approval of the submission documents.

15.2. AUTOMATIC DETECTION AND NOTIFICATION SYSTEMS:

15.2.1. Unless otherwise noted, systems shall meet the requirements of the most recent edition of the following publications: National Fire Protection Association (NFPA) 70, 72, 75 and 90A and 101.

15.2.1.1. Provide separate fire protection (FP-__) drawings in the plan sets. The minimum design drawing requirements for detection systems are as follows: occupancy hazard classifications, graphically depicted

locations of all fire rated walls with rating indicated and locations of all devices on a dedicated floor plan and location of fire alarm control panel. Also show the suggested routing for all fire system conduit. In addition, provide a riser diagram that clearly defines the individual zones and devices as well as clearly showing all connections "by others".

- 15.2.2. Since automatic suppression systems shall be provided in all Air National Guard Facilities, automatic detection systems shall be kept to an absolute minimum. These include areas such as sleeping quarters, air handling systems where required by code, exit corridors other areas as outlined in the matrix to follow. . This criteria is mandatory for all new construction and renovations/additions where the renovation/addition costs exceeds 50% replacement value of the facility. In those cases
- 15.2.3. Facility fire detection and alarm systems shall consist of automatic smoke and heat detection systems and manual pull stations for each facility. The system shall provide local audio and visual alarm throughout the facility interior and exterior. To avoid conflict with systems furniture workstations, locate audio and visual alarm devices on ceiling or mount high on wall. The system shall also provide radio based, fiber optic or landline based remote system reporting to the base central system and a secondary central receiver. Provide radio based transmission systems for all new base-wide systems. Match existing standard for construction of new facilities with the existing base system. All facility fire systems must also transmit appropriate signals to the responding (host or other) fire department, which in most cases is the ANG fire station.
- 15.2.4. Base central automatic fire alarm receiving and reporting systems are required and provide for the transmission/receiving of fire, emergency (eyewash station, POL, VMF or Fuel Cell fuel leak detection, etc.), trouble, tamper, Knox box, HVAC duct detector, system restore signals, manual pull station activation, suppression system activation, flow alarm, HEF system activation and other information from all base detection, alarm and suppression systems. Reporting shall report all information for each system by zone and by system. A general fire or trouble signal is not an acceptable minimum. The base central system is generally located in the responding (ANG or Host base) fire department alarm and communication center. A remote secondary receiver is typically located at 24-hour manned Security Forces or Command post. Provide built in casework and workstation for the receiving systems in both the fire station and the security or command post. Receiving system shall be PC based, complete with all programming, graphics, etc.
- 15.2.5. All new systems shall be compatible with existing base systems, as to brand and models of panels and transmission system. All new systems shall be capable of reporting properly to the base central systems.
- 15.2.6. All detection and alarm systems shall be of the supervised Class A Style D for initiating circuits and a supervised Class A Style Z for notification appliance circuits.. All fire detection and alarm system wiring shall be run in minimum 1.9 cm (3/4 inch) EMT conduit complete and shall be clearly identified. Systems shall utilize supervise non-proprietary generic type devices. Devices shall be interchangeable with other brands that are readily available
- 15.2.7. Wiring shall be THHN or TFFN stranded with crimp on terminal ends affixed. All terminal ends shall be clearly marked and numbered as to appropriate terminal and device. All wiring shall be color-coded and fully identified and standard throughout the facility. Use of multi-conductor twisted pair or similar wiring is not permitted. The use of wire nuts in fire protection systems is prohibited. Slicing of wire shall not be permitted. All wiring is to be continuous from panel to device and device to device. Terminal blocks shall be used only where absolutely necessary, e.g. devices with integral pig tails, such as Rate Compensated Heat Detectors. "T" tapping is also prohibited.

- 15.2.8. All detection and alarm wire shall be installed in separate conduits. Each circuits outgoing and return conductors exiting and returning to the control unit, respectively are to be routed separately as required NFPA 72. The minimum separation of outgoing and return conduits shall be .3 meters (1 foot) vertically and 1.2 meters (4 feet) horizontally. Conduit shall be EMT conduit. Exception would be those locations deemed unsuitable for EMT conduit. In such cases, use Rigid or PVC type conduit. Minimum conduit size shall be 1.9 cm (3/4 inch) diameter trade size. Alarm and supervisory wiring shall be in separate conduits. Use of FMC or Liquid-Tite is not permitted except in areas subject to extreme vibration. In those rare instances, no more than a six-foot length may be specified. All conduletes and junction boxes shall be identified in **RED** color coding and labeling.
- 15.2.9 Systems shall include full identification. All junction, terminal and pulling boxes and covers shall be painted the color red and shall be identified with engraved labels by the zone and circuit that it contains. All conduletes and similar units shall be painted the color red. All detection and terminal devices shall have engraved plastic or metallic alphanumeric identification, which shall be keyed to the posted operations and maintenance instructions
- 15.2.10. Manual fire and evacuation alarm systems (pull stations) are to be provided at all facility exits regardless of other systems provided and shall provide both local audio and visual alarm. Manual systems shall be provided at all exits , along paths of egress, on every floor, , in shops, mechanical rooms electrical rooms and storage spaces and in other where the path of egress is directly to the exterior, as well as where it is logical to incorporate. Provide manual pull stations in unobstructed locations. Do not provide for installation on the hinged side of doors except in the case of double doors. These systems may not be used in lieu of automatic detection systems, but they are required to supplement certain suppression systems.
- 15.2.11. All detectors shall be of the heat type, except in sleeping quarters and exit corridors where combination heat/smoke detectors are shall be used, and ducts where in-duct detector units shall be used. For open office, systems furniture areas, provide a heat/smoke detector at close proximity to each space exit door. For raised floor systems areas, provide smoke or combination heat/smoke detectors below the raised floor panels. All sleeping quarters shall have combination heat/smoke detectors and CO detectors, all of which are monitored by the building Fire Alarm Panel.
- 15.2.12. Provide duct type smoke detectors, complete with fan shutdown relays (manual reset) for all air handling systems over 56.6 cubic meters per minute (2000 cfm). Provide detectors for both supply and return duct systems. Provide duct smoke detectors in accordance with NFPA 90A for HVAC systems. At all locations that a duct detector is installed, provide remote test switch (install at 2.1 meters (7 feet) above finish floor elevation) and LED indicator for maintenance and alarm identification.
- 15.2.13. The fire alarm control panel for each facility's detection system shall be located in either the fire protection room or mechanical or electrical room with outside access. Each facility shall be divided into multiple zones. Specific functions such as duct detectors, range hoods, eyewash stations and air-handling units equipped with duct detectors shall be wired as individual zones. Provide two or more spare zones depending on facility size. Facilities over 465 square meters (5,000 square feet) shall have a minimum of 4 spare zones provided. Facilities over 1858 square meters (20,000 square feet) shall have a minimum of 6 spare zones provided. All fire alarm system conduits in occupied spaces shall be recessed and not visible. .
- 15.2.14. Fire Alarm panels shall be field expandable. Systems shall be non-addressable (HEF systems have specific requirements, see HEF section for further information). Panels may be field programmable provided that this can be accomplished at the unit (panel) level, without the use of proprietary software, keys, the changing of electronic hardware, or use of any proprietary device (unless provided to the ANG at time of installation). Any software, device, password or other element used to program any component of the fire system shall be specified to become property of the Government, along with the installed program. All panels shall include input and output modules and terminations. All zones to be transmitted to the central systems for fire and trouble, on a zone by zone basis. All detection and suppression systems shall be simple and reliable. They shall use proven technology and shall avoid the use of proprietary or copy righted technology.

- 15.2.15. Fire alarm and suppression panels shall be complete from the factory and shall not require any field modifications or additions to perform the intended function.
- 15.2.16. Fire system battery systems shall be of the sealed gel-cell maintenance free type. Batteries shall be located upright, in the fire alarm panel and not in separate panels. Battery capability shall be capable of maintaining fire alarm operations for a minimum of 60 hours and 5 minutes under alarm mode in the event of a power outage.
- 15.2.17. All facility fire system components shall be complete and shall be of the same manufacturer. Where the base has existing fire alarm systems, it is recommended that all new systems be of that same base standard manufacturer. Where possible, it is recommended that the system interface with base EMCS system for monitoring purposes only.
- 15.2.18. All panels and devices shall be UL or FM listed for their intended application.

The following is the "Fire Alarm System Checklist for Acceptance" document for reference purposes.

Fire Alarm System Checklist for Acceptance

Fire Alarm System

- Do the specifications require the "Manufacturers Representative" to attend and supervise the startup? If Yes, Is the Rep. on site?
- Did the contractor provide the NFPA 72 "Record of Completion", completely filled out and signed?
- Did the contractor provide the NFPA 72 "Test and Inspection" form filled out for the preliminary tests,
- Did the contractor complete and submit the wiring report, with all of the ohm readings.
- Is the panel a complete, conventional system from the factory?
- Is the fire alarm system "completely" finished?
- Did the contractor submit the battery calculations for the installed panel, and devices? Do the calculations match the batteries that are installed?
- Are all of the initiating circuits wired as "Class A, Style D"
- Are all of the indication circuits wired as "Class A, style Z"
- Are the wiring THHN, or TFFN single conductor clearly identified, and color-coded, through-out the entire system, as to their function? (Example, Red & black – bells, blue & yellow – tampers)
- Are all zones clearly marked as to what they are? (Heats – over panel, Smokes, Duct Detector – north unit, Pull Stations – south wing, Etc.)
- Are there zone-by-zone "outputs" for each of the zones, thru the transmission media to the fire station?
- Has the system been burned in for several days, without problems?
- Are the batteries completely charged?
- Is the fire alarm panel clear (normal), no alarms or troubles?
- Is the fire alarm panel being used as a raceway for wiring passing thru to other panels, or devices?
- Did the contractor install a power booster for the indicating circuits?

- Did the contractor install any modules, relays, or devices in the fire alarm panel that is foreign to it? (An example would be a surge suppressor, or relay for HVAC shutdown)
- Did the contractor identify all interfaced equipment modules, relays, or devices as to what they are and control?
- Did the contractor identify each wire with wire markers on each end, and complete a point-to-point, as built drawing?
- Has the fire alarm system wiring been installed completely in conduit, a minimum of 3/4" trade size.
- Is there a smoke detector mounted at the fire alarm panel, specifically for the protection of the panel.
- Are the outgoing, and return circuit conductors for each zone in separate conduits?
- Is the fire alarm system free of wire nuts, and unnecessary splices?
- Are splices that are absolutely necessary on terminal blocks, with all wires identified with wire markers on each conductor?
- Are there pull stations at (within 5') every exit door, and mounted on the striker side?
- Do the halls have "heat/smoke Detectors"?
- Do the duct detectors have remote test switches where needed? , And are they mounted at 7 feet AFF?
- Are their "visual" devices in the restrooms?
- Are the devices in the restroom heats and not smokes?
- Are there audio/visual devices and a pull station in the Mechanical room?
- Are the conduits & boxes marked, or painted red to identify them?
- Are all devices in place?

Radio Transmission Media

- Has the factory representative been retained to do the startup, and complete the factory forms?**
- Have all zones been programmed and verified to both the fire alarm panel, and the central at the fire station?**
- Has the antenna system been checked, and tested, and has documentation been provided?**
- Is the surge suppressor grounded, and is the grounding bonded to the electrical service ground?**
- Have all zones been tested for fire and trouble, and has documentation been provided?**

Test the following:

- Test fire alarm panel for battery supervision**
- Test fire alarm panel for AC power supervision**
- Test panel for indicating circuit supervision**
- Test all pull stations for fire and trouble**
- Test all heat detectors for fire and trouble**
- Test all smoke detectors for fire and trouble**
- Test all duct detectors for fire and trouble**
- Test all duct detector remote test switches for proper operation**
- Test all flow switches**
- Test all tamper switches**
- Test HVAC shutdown (if required by specifications)**
- Test Power booster for supervision, and battery operation**
- Test system on batteries (under load) for 24, 60, or 72 hours as appropriate**
- Verify appropriate signal thru transmission media to fire station for ALL fire, trouble and supervisory signals (zones).**
- Test all horn/strobes and bells for function & opens**
- Test supervision of door closures (if installed)**
- Test supervision of shunt trip breakers (if installed)**
- Test supervision of dry chemical systems (if installed)(do-not set off system)**
- Test operation of drop – doors (if electrically triggered)**
- Test voice operation of the Mass Notification to insure it interrupts's the audible fire alarm notification appliances, and initiates a trouble signal to the fire department.**
- Test each zone from the transmission media by creating an open at the transmission panel.**
- Test the AC & DC power supervision at the transmission media panel**

End of Section

SECTION 283150 - MASS NOTIFICATION SYSTEM

PART 1 - GENERAL

1.1 REFERENCES:

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.
1. American National Standards Institute (ANSI):
 - a. S3.2 - Method for Measuring the Intelligibility of Speech Over Communications Systems.
 - b. S3.41 - Audible Emergency Evacuation Signal.
 2. Institute of Electrical and Electronics Engineers (IEEE):
 - a. C62.41 - Surge Voltages in Low-Voltage AC Power Circuits.
 3. International Electrochemical Commission (IEC):
 - a. 60849 - Sound Systems For Emergency Purposes.
 - b. 60268 - The Objective Rating of Speech Intelligibility by Speech Transmission Index.
 4. National Fire Protection Association (NFPA):
 - a. 1221 - Installation, Maintenance and Use of Public Fire Service Communication Systems.
 - b. 70 - National Electrical Code.
 - c. 72 - National Fire Alarm Code.
 5. U.S. National Archives and Records Administration (NARA):
 - a. 47 CFR 15 - Radio Frequency Devices.
 6. Occupational Safety and Health Administration (OSHA):
 - a. 29 CFR 1910.165 - Employee Alarm Systems
 7. Underwriters Laboratories (UL):
 - a. 1242 - Intermediate Metal Conduit.
 - b. 1480 - Speakers for Fire Alarm, Emergency, and Commercial and Professional Use.
 - c. 1971 - Signaling Devices for the Hearing Impaired.
 - d. 464 - Audible Signal Appliances.
 - e. 6 - Rigid Metal Conduit.
 - f. 632 - Electrically-Actuated Transmitters.
 - g. 797 - Electrical Metallic Tubing.
 - h. 864 - Control Units for Fire Protective Signaling Systems.

1.2 SUBMITTALS:

- A. The following shall be submitted in accordance with DIVISION 1.
1. Shop Drawings:

a. Mass Notification System:

Detail Drawings consisting of a complete list of equipment and material, including manufacturer's descriptive and technical literature, catalog cuts, and installation instructions. Note that the Contract Drawings show layouts based on typical devices. The Contractor shall check the layout based on the actual devices to be installed and make any necessary revisions in the Detail Drawings. The Detail Drawings shall also contain complete wiring and schematic diagrams for the equipment furnished, equipment layout, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Detailed point-to-point wiring diagram shall be prepared showing points of connection. Diagram shall include connections between system devices, appliances, control panels, supervised devices, and equipment that is activated or controlled by the panel.

2. Product Data:

a. Storage Batteries:

- (1) Substantiating battery calculations for supervisory and alarm power requirements. Ampere-hour requirements for each system component and each panel component, and the battery recharging period shall be included.

b. Voltage Drop:

- (1) Voltage drop calculations for notification appliance circuits to indicate that sufficient voltage is available for proper appliance operation.

c. Special Tools and Spare Parts:

- (1) Spare parts data for each different item of material and equipment specified, not later than 3 months prior to the date of beneficial occupancy. Data shall include a complete list of parts and supplies with the current unit prices and source of supply and a list of the parts recommended by the manufacturer to be replaced after 1 year of service.

d. Technical Data and Computer Software.

e. Technical data which relates to computer software.

f. Training:

- (1) Lesson plans, operating instructions, maintenance procedures, and training data, furnished in manual format, for the training courses. The operations training shall familiarize designated government personnel with proper operation of the mass notification system. The maintenance training course shall provide the designated government personnel adequate knowledge required to diagnose, repair, maintain, and expand functions inherent to the system.

g. Testing: Detailed test procedures for the mass notification system 60 days prior to performing system tests.

3. Test Reports:

a. Testing:

- (1) Test reports, in booklet form, showing field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall document readings, test results and indicate the final position of controls.

4. Certificates:

a. Equipment:

- (1) Certified copies of current approvals or listings issued by an independent test lab if not listed by UL, FM or other nationally recognized testing laboratory, showing compliance with specified UFG standards.

- b. Qualifications: Proof of qualifications for required personnel. The installer shall submit proof of experience for the technician and the installing company.
5. Operation and Maintenance Data:
- a. Technical Data and Computer Software:
 - (1) Six copies of operating manual outlining step-by-step procedures required for system startup, operation, and shutdown. The manual shall include the manufacturer's name, model number, service manual, parts list, and complete description of equipment and their basic operating features. Six copies of maintenance manual listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The manuals shall include conduit layout, equipment layout and simplified wiring, and control diagrams of the system as installed. The manuals shall include complete procedures for system revision and expansion, detailing both equipment and software requirements. Original and backup copies of all software delivered for this project shall be provided, on each type of media utilized. Manuals shall be approved prior to training.
- 1.3 GENERAL REQUIREMENTS:
- A. Standard Products:
 - 1. Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that can provide service within 24 hours of notification.
 - B. Nameplates:
 - 1. Major components of equipment shall have the manufacturer's name, address, type or style, voltage and current rating, and catalog number on a noncorrosive and nonheat-sensitive plate which is securely attached to the equipment.
 - C. Keys and Locks;
 - 1. Locks shall be keyed alike. Four keys for the system shall be provided.
 - D. Tags:
 - 1. Tags with stamped identification number shall be furnished for keys and locks.
 - E. Verification of Dimensions:
 - 1. After becoming familiar with details of the Work, the Contractor shall verify dimensions in the field and shall advise the Contracting Officer of any discrepancy before performing the Work.
 - F. Compliance:
 - 1. The equipment furnished shall be compatible and be UL listed, FM approved, or approved or listed by a nationally recognized testing laboratory in accordance with the applicable standards.

G. Qualifications:

1. The installing Contractor shall provide mass notification technicians who are factory trained in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.

1.4 SYSTEM DESIGN:

Operation: The mass notification system shall be a complete, supervised mass notification system. The system shall consist of an autonomous control unit to monitor and control the notification appliance network, a local operator control unit for initiating local operation, and a telephone paging interface for paging capability outside the mass notification voice announcement function. Using the local operator control unit, personnel in the building shall be able to initiate delivery of pre-recorded voice messages by the push of a button or the flip of a switch, provide live voice messages and instructions utilizing a microphone, and initiate visual strobe notification appliances. Upon activation of a pre-recorded or live voice message from the local operator control unit while the building fire alarm is in an alarm state, the autonomous control unit shall override the manual or automatic fire alarm notification functions while the mass notification voice messages are being delivered. In addition, upon activation of a pre-recorded or live voice message from the local operator control unit, the control unit shall temporarily deactivate the building autonomous paging system functions. Textual, audible, and visual appliances and systems shall comply with NFPA 72. Mass notification system components requiring power shall operate on 24Vdc except where otherwise indicated. System shall provide the following features:

1. Sufficient capacity to perform as specified.
2. UL 864, MEA, CSFM, CUL, FCC PART 15, CE approved. OSHA 29 CFR 1910.165 compliant and ADA compliant.
3. Supervised notification appliance circuit (NAC) and expansion equipment circuits.
4. Four digitally pre-recorded voice messages that can be automatically triggered. Contents of the messages shall be obtained from the Contracting Officer.
5. Built-in 24Vdc power supply and charger.
6. Fully supervised on-board diagnostics and trouble reporting circuits.
7. 70.7V amplifier(s) and expansion amplifier(s).

B. Operational Features: The system shall have the following operating features:

1. Monitor electrical supervision of NAC.
2. Monitor electrical supervision of primary power (ac) supplies, and battery voltage.
3. A trouble buzzer and trouble LED/LCD (light emitting diode/liquid crystal diode) to activate upon a single break, open, or ground fault condition preventing the required normal operation of the system. The trouble signal shall also operate upon loss of primary power (ac) supply, low battery voltage. A trouble alarm silence switch shall be provided which will silence the trouble buzzer, but will not extinguish the trouble indicator LED/LCD. Subsequent trouble and supervisory alarms shall sound the trouble signal until silenced. After the system returns to normal operating conditions, the trouble buzzer shall again sound until the silencing switch returns to normal position, unless automatic trouble reset is provided.
4. Capacity for a minimum of four pre-recorded messages. The minimum total time allowable for all four messages combined shall be two minutes.
5. Live microphone override from the local operator control unit. A key shall be required for microphone operation.
6. Ability to function connected to a base-wide control system and/or as an independent building system. The building mass notification system shall be completely operable without a base-wide system installed and shall be capable of operating independently of any other system within the building. The system shall be able to send all trouble signals to a base-wide control system. The connection between the individual building

mass notification system and the base-wide system devices shall be able to be electrically supervised.

7. Deactivate fire alarm audible notification appliances while delivering voice messages and then, after voice message termination, immediately reactivate the fire alarm audible notification appliances. Deactivation of the fire alarm audible notification appliances shall occur only when both the fire alarm panel is in alarm condition and a voice message is to be transmitted by the mass notification system. Only the fire alarm system audible notification appliances shall be deactivated. All other features of the fire alarm system, including the operation of visual notification devices and transmission of signals to the fire department, shall remain unaffected. Deactivation of fire alarm audible notification appliances by the autonomous control unit shall cause a separate supervisory signal in the fire alarm system and shall transmit this signal to the fire department's central receiving station. Visual annunciation of the separate supervisory signal shall be distinctly labeled or otherwise clearly identified on the fire alarm panel.
 8. Adequate discrete outputs to temporarily deactivate fire alarm audible notification appliances, deactivate telephone paging function, deactivate intercom system, and initiate/synchronize strobes.
 9. Ability to automatically repeat selected pre-recorded messages until manually terminated.
 10. Deactivate paging system when a live or pre-recorded voice message is activated at the same time the paging function is being utilized. Paging function shall immediately be reactivated once the voice message is terminated.
 11. Volume controls. One control to be utilized for mass notification voice messages made from the local operator control unit or the base-wide system. The volume control for mass notification voice announcements shall be preset and shall be adjustable only from the autonomous control unit.
 12. Ability to synchronize mass notification visual devices with the fire alarm visual devices.
- C. Mass Notification System Activation:
1. Manual activation shall initiate the following functions:
 - a. Deliverance of either one of the 4 distinct pre-recorded voice messages or a live voice message from the secure microphone.
 - b. Activation of visual (strobe) mass notification appliances throughout the building when one of the pre-recorded messages or a live voice message is activated.
 - c. Deactivation of the fire alarm audible notification appliances throughout the building.
 - d. Deactivation of the paging function throughout the building.
 - e. Deactivation of the intercom function throughout the building.
- D. Primary Power:
1. Operating power shall be provided as required by paragraph Power Supply for the System. Transfer from normal to emergency power or restoration from emergency to normal power shall be fully automatic and not cause transmission of a false alarm. Loss of ac power shall not prevent transmission of a signal via the mass notification system upon operation of any initiating circuit.
- E. Battery Backup Power:
1. Battery backup power shall be through use of rechargeable, sealed-type storage batteries and battery charger.

F. Interface With Fire Alarm Equipment:

- 1. The equipment specified herein shall be separate from the fire alarm system. The mass notification system equipment shall be interfaced/connected to the fire alarm system to deactivate the fire alarm audible notification appliances and synchronize visual notification appliances between the two systems. The deactivation of the fire alarm audible notification appliances shall cause a supervisory signal at the fire alarm control panel.

1.5 TECHNICAL DATA AND COMPUTER SOFTWARE:

- A. Technical data and computer software (meaning technical data which relates to computer software) which is specifically identified in this project, and which may be defined/required in other specifications, shall be delivered, strictly in accordance with the CONTRACT CLAUSES, and in accordance with DIVISION 1. Data delivered shall be identified by reference to the particular specification paragraph against which it is furnished. Data to be submitted shall include complete system, equipment, and software descriptions. Descriptions shall show how the equipment will operate as a system to meet the performance requirements of this Contract. The data package shall also include the following:

- 1. Identification of programmable portions of system equipment and capabilities.
- 2. Description of system revision and expansion capabilities and methods of implementation detailing both equipment and software requirements.
- 3. Provision of operational software data on all modes of programmable portions of the mass notification system.
- 4. Description of Mass Notification Control Panel equipment operation.
- 5. Description of auxiliary and remote equipment operations.
- 6. Library of application software.
- 7. Operation and maintenance manuals as specified in 1.02-5 of the Submittals paragraph.

1.6 DELIVERY AND STORAGE:

- A. Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt, dust, and any other contaminants.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. Monaco Enterprises, Inc. is a manufacturers whose mass communication system meets this Specification.

2.2 AUTONOMOUS CONTROL UNIT:

- A. Control unit shall comply with the applicable requirements of UL 864. Unit shall be modular, installed in a surface mounted steel cabinet with hinged door and cylinder lock. Control unit shall be a clean, uncluttered, and orderly assembled panel containing components and equipment required to provide the specified operating and supervisory functions of the system. The unit shall have prominent rigid plastic, phenolic or metal identification plates for LED/LCDs, zones, signal line circuits, controls, meters, fuses, and switches. Nameplates for fuses shall also include ampere rating. The LED/LCD displays shall be located on the exterior of the cabinet door or be visible through the cabinet door. Control unit switches shall be within the locked cabinet. A suitable means (single operation) shall be provided for testing the control unit's visual indicating devices (meters or LEDs/LCDs). Meters and LEDs shall be plainly visible when the cabinet door is closed. Signals and LEDs/LCDs shall be provided to indicate any alarm, supervisory or trouble condition on the system. Loss of power, including batteries, shall not require the manual reloading of a program. Upon restoration of

power, startup shall be automatic, and shall not require any manual operation. The loss of primary power or the sequence of applying primary or emergency power shall not affect the transmission of alarm, supervisory or trouble signals. Visual annunciation shall be provided for LED/LCD visual display as an integral part of the control unit and shall identify with a word description and ID number each device. Cabinets shall be provided with ample gutter space to allow proper clearance between the cabinet and live parts of the unit equipment. If more than one modular unit is required to form a control unit, the units shall be installed in a single cabinet large enough to accommodate all units. Cabinets shall be painted manufacturer's standard color.

B. Power Amplifier:

1. Power amplifiers as a minimum shall conform to the following specifications:
 - a. Rated power output: As shown in watts RMS.
 - b. Frequency Response Music: Plus or Minus 3 dB, 100-15,000 Hz.
 - c. Frequency Response Voice Override: Plus or Minus 3 dB, 275-6,500 Hz.
 - d. Distortion: Less than 2 percent at RPO, 600-13,000 Hz.
 - e. Input: As required by system and 1 Aux.
 - f. Output voltage: 25 and 70.7 volts.
 - a. Power Requirement: 110-125Vac 60 Hz.

B. Visual Notification Power (Strobes):

1. The visual notification power unit shall be sized for a minimum of 10% greater power than required for the number of strobes shown connected to the Autonomous Control Panel.

C. Circuit Connections: Circuit conductors entering or leaving the panel shall be connected to screw-type terminals with each conductor and terminal marked for identification.

D. System Expansion and Modification Capabilities: Any equipment and software needed by qualified technicians to implement future changes to the mass notification system shall be provided as part of this Contract.

2.2 SYSTEM EXPANSION EQUIPMENT:

A. Power Amplifier:

1. Power amplifiers as a minimum shall conform to the following specifications:
 - a. Rated power output: As shown in watts RMS.
 - b. Frequency Response Music: Plus or Minus 3 dB, 100-15,000 Hz.
 - c. Frequency Response Voice Override: Plus or Minus 3 dB, 275-6,500 Hz.
 - d. Distortion: Less than 2 percent at RPO, 600-13,000 Hz.
 - e. Input: As required by system.
 - f. Output voltage: 25 and 70.7 volts.
 - g. Power Requirement: 110-125Vac 60 Hz.

B. Visual Notification Power (Strobes):

1. The visual notification power unit shall be sized for a minimum of 10% greater power than required for the number of strobes shown connected to the expansion equipment.

2.3 LOCAL OPERATOR CONTROL UNIT WITH MICROPHONE:

- A. The unit's microphone shall be a supervised hand held push to talk microphone and a key shall be required to enable microphone use. Removable wiring terminals for quick connect/disconnect accepting 12 - 22 AWG shall be incorporated. All output circuitry shall be power limited. Individual front panel LED's shall be provided for indication of System Normal, System Trouble and Alarm. Multiple on board diagnostic LED's shall be provided. Voice frequency response shall be 275 Hz - 6.5 kHz +/- 2.4 dB. Power requirements shall be 24Vdc and will be supplied by the Autonomous Control Unit. Controls shall be provided for start and stop of the four pre-recorded messages. Unit shall be mounted as indicated on the drawings.

2.4 STORAGE BATTERIES:

- A. Storage batteries shall be provided and shall be 24 Vdc sealed, lead-calcium type requiring no additional water. The batteries shall have ample capacity, with primary power disconnected, to operate the mass notification system for a period of 72 hours. Following this period of battery operation, the batteries shall have ample capacity to operate all components of the system, including all alarm signaling devices in the total alarm mode for a minimum period of 60 minutes. Batteries shall be located in a separate battery cabinet. Batteries shall be provided with overcurrent protection in accordance with NFPA 72. Separate battery cabinets shall have a lockable, hinged cover similar to the fire alarm panel. The lock shall be keyed the same as the fire alarm control panel. Cabinets shall be painted to match the mass notification control panel.

2.5 BATTERY CHARGER:

- A. Battery charger shall be completely automatic, 24 Vdc with high/low charging rate, capable of restoring the batteries from full discharge (18Vdc) to full charge within 48 hours. A pilot light indicating when batteries are manually placed on a high rate of charge shall be provided as part of the unit assembly, if a high rate switch is provided. Charger shall be located in control panel cabinet or in a separate battery cabinet.

2.6 NOTIFICATION APPLIANCES:

- A. Devices shall be connected into notification appliance circuits. Devices shall have a separate screw terminal for each conductor. Audible appliances, if other than voice, shall generate a unique audible sound from other devices provided in the building and surrounding area. Surface mounted audible appliances shall be painted white. Recessed audible appliances shall be installed with a grill that is painted white.
- B. Speakers: Speakers shall be capable of operating at 70.7 nominal Vrms. Speakers shall be compliant with UL 1480 for protective signaling systems. Power taps shall be selectable by shunts.
- C. Visual Notification Appliances:
 - 1. Visual notification appliances shall conform to the applicable requirements of UL 1971 and the Contract Drawings. Appliances shall have clear high intensity optic lens, xenon flash tubes, and output white light. Strobe flash rate shall be between 1 to 3 flashes per second and a maximum of 110 candela. Candela rating shall be as shown. Strobe shall be semi-flush mounted unless indicated otherwise. Mass notification strobes shall be un- marked, with amber colored lenses. Visual devices shall be synchronizable.
 - 2. Mass Notification and Fire Alarm strobes shall be synchronized such that if one stem (FA or MNS) strobes are functioning, a momentary (less than 3 cycles or 1/20th of a second) break in circuit shall allow common strobe synchronization to energize both

system strobes.

D. Voice System:

1. The voice evacuation system shall provide for one-way voice communications, routing and pre-amplification of voice messages. System shall meet intelligibility as defined in NFPA 72. It should be measured in accordance with IEC 60849 and IEC 60268.

2.7 MASS NOTIFICATION SYSTEM PERIPHERAL EQUIPMENT:

A. Conduit:

1. Conduit and fittings shall comply with NFPA 70, UL 6, UL 1242, and UL 797.

B. Wiring:

1. Wiring shall conform to NFPA 70. Wiring for 120Vac power shall be No. 12 AWG minimum. The wiring shall be copper cable in accordance with the manufacturers requirements. Wiring for mass notification dc circuits shall be No. 14 AWG minimum, unless indicated otherwise on the drawings. Voltages shall not be mixed in any junction box, housing, or device, except those containing power supplies and control relays. Wiring shall conform to NFPA 70. System field wiring shall be solid copper and installed in metallic conduit or electrical metallic tubing. Conductors shall be color coded. Conductors used for the same functions shall be similarly color coded. Wiring code color shall remain uniform throughout the circuit. Pigtail or T-tap connections to supervisory alarm circuits, and notification appliance circuits are prohibited.

C. Special Tools and Spare Parts:

1. Software, connecting cables, and proprietary equipment, necessary for the maintenance, testing, and reprogramming of the equipment shall be furnished to the Contracting Officer. Two spare fuses of each type and size required shall be furnished.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. All work shall be installed as shown, and in accordance with NFPA 70 and NFPA 72, and in accordance with the manufacturer's diagrams and recommendations, unless otherwise specified.

B. Power Supply for the System:

1. Dedicated circuit connections for supplying power from a branch circuit to each mass notification system component shall be provided as indicated on the drawings. Each power supply shall be equipped with a locking mechanism and marked in red with the words "MASS NOTIFICATION SYSTEM CIRCUIT CONTROL".

C. Wiring:

1. Conduit size for wiring shall be in accordance with NFPA 70. Wiring for the mass notification system shall not be installed in conduits, junction boxes, or outlet boxes with conductors of lighting and power systems. Not more than two conductors shall be installed under any device screw terminal. The wires under the screw terminal shall be straight when placed under the terminal then clamped in place under the screw terminal. The wires shall be broken and not twisted around the terminal. Circuit conductors entering or leaving any mounting box, outlet box enclosure, or cabinet shall be connected to screw terminals with each terminal and conductor marked in accordance with the wiring diagram. Connections and splices shall be made using screw terminal blocks. The use of wire nut type connectors in the system is prohibited. Wiring within any control equipment shall be readily accessible without removing any component parts. The mass notification system equipment manufacturer's representative shall be present for the connection of wiring to the control panel. Minimum size of conduit shall be 3/4".

D. Autonomous Control Unit and Expansion Amplifiers:

1. The control unit and expansion amplifiers and their assorted components shall be mounted so that no part of the enclosing cabinet is less than 12 inches nor more than 78 inches above the finished floor. Manually operable controls shall be between 36 and 44 inches above the finished floor. Panel shall be installed to comply with the requirements of UL 864.

E. Notification Appliances:

1. Notification appliances shall be mounted 80 inches above the finished floor or 6 inches below the ceiling, whichever is lower, unless indicated otherwise. Coordinate locations of mass notification devices with fire alarm devices.

3.2 OVERVOLTAGE AND SURGE PROTECTION:

A. Power Line Surge Protection:

1. All equipment connected to alternating current circuits shall be protected from surges per IEEE C62.41 B3 combination waveform and NFPA 70. Fuses shall not be used for surge protection. The surge protector shall be rated for a maximum let thru voltage of 350Vac (line-to-neutral) and 350Vac (neutral-to-ground).

B. Low Voltage DC Circuits Surge Protection:

1. All cables/conductors shall have surge protection installed at each point where it exits or enters a building. Equipment shall be protected from surges per IEEE C62.41 B3 combination waveform and NFPA 70. The surge protector shall be rated to protect the 24Vdc equipment. The maximum dc clamping voltages shall be 36 V (line-to-ground) and 72Vdc (line-to-line).

3.3 GROUNDING:

- A. Grounding shall be provided by connecting to building ground system.

3.4 TESTING:

- A. The Contractor shall notify the Contracting Officer at least 14 days before the performance and acceptance tests are to be conducted. The tests shall be performed in accordance with the approved test procedures in the presence of the Contracting Officer. The control panel manufacturer's representative shall be present to supervise tests. The Contractor shall furnish instruments and personnel required for the tests.
- B. Performance Tests:
 - 1. The system shall be subjected to functional and operational performance tests including tests of each installed initiating and notification appliance, when required. Tests shall include the meggering of system conductors to determine that the system is free from grounded, shorted, or open circuits. The megger test shall be conducted prior to the installation of mass notification equipment. If deficiencies are found, corrections shall be made and the system shall be retested to assure that it is functional. After completing the performance testing the Contractor shall complete a witnessed acceptance test of the mass notification system. Performance testing shall be spot-checked by local representatives and the authority having jurisdiction at the installation.
- C. Acceptance Test:
 - 1. Acceptance testing shall not be performed until the Contractor has completed and submitted the Certificate of Completion. The recommended tests in NFPA 72 shall be considered mandatory and shall verify that previous deficiencies have been corrected. The Contractor shall complete a witnessed acceptance test of the system. The test shall include all requirements of NFPA 72 and the following:
 - a. Test of each function of the control panel.
 - b. Test of each circuit in both trouble and normal modes.
 - c. Tests of the voice messaging, live and pre-recorded, systems.
 - d. Tests of each control circuit and device.
 - e. Tests of each alarm notification appliance.
 - f. Tests of the battery charger and batteries.
 - g. Complete operational tests under emergency power supply.
 - h. Visual inspection of wiring connections.
 - i. Opening the circuit at each notification appliance to test the wiring supervisory feature.
 - j. Ground fault.
 - k. Short circuit faults.
 - l. Stray voltage.
 - m. Loop resistance.
 - n. Test of fire alarm (deactivation of fire alarm audible devices) interface and operation.
 - o. Voice intelligibility test of both live and pre-recorded messages.

3.5 TRAINING:

- A. Training course shall be provided for the operations and maintenance staff. The course shall be conducted in the building where the system is installed or as designated by the Contracting Officer. The training period for systems operation shall consist of 1 training day (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests. The training period for systems maintenance shall consist of 2 training days (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests. The instructions shall cover items contained in the operating and maintenance instructions. In addition, training shall be provided on performance of expansions or modifications to the mass notification system.

END OF SECTION 283150

SECTION 31 2000 – EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Missouri "Standard Specifications for Highway Construction", Section 403 "Asphaltic Concrete Pavement", 1999 and latest revisions.
- C. "Geotechnical Engineering Report 139th Security Forces Building at Rosecrans Memorial Airport near the intersection of Panigot Road and 26th Road, St. Joseph, Missouri", November 21, 2013, Terracon Consultants, Inc.
 - 1. The complete Geotechnical Report is available from the office of the Architect. Boring logs from the report are attached at the end of this section as a reference.
- D. "Construction Observation Manual", City of St. Joseph, Missouri, Department of Public Works, latest edition.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Preparing subgrades for slabs-on-grade, walks, pavements, lawns and grasses and exterior plants.
 - 2. Drainage course for slabs-on-grade.
 - 3. Subbase course for concrete walks pavements.
 - 4. Subbase course and base course for asphalt paving.
 - 5. Subsurface drainage backfill for walls and trenches.
 - 6. Excavating and backfilling trenches for utility trenches.
 - 7. Preparing subgrades for slabs-on-grade
- B. Related Sections include the following:
 - 1. Division 01 Section "Temporary Facilities and Controls" for temporary controls, utilities and support facilities.
 - 2. Division 31 Section "Site Clearing" for temporary erosion and sedimentation control measures, site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below grade improvements and utilities.
 - 3. Division 03 Section "Cast-In-Place Concrete" for granular course if placed over vapor retarder and beneath the slab-on-grade.
 - 4. Divisions 22, 31, 32 and 33 Sections for installing underground mechanical and electrical utilities and buried mechanical and electrical structures.

1.3 DEFINITIONS

- A. Backfill: Job excavated material free from debris, organic material, and large stones.

1. Initial Backfill: Backfill placed on top of the haunching material in the trench from the spring line to 12" above the top of pipe.
 2. Final Backfill or trench backfill: Backfill placed over initial backfill/embedment to fill a trench.
- B. Base Course: Aggregate layer placed between the subgrade course and hot-mix asphalt paving or between the subgrade course and concrete pavement.
1. ASTM C-33 Size No. 57 Aggregate or similar
- C. Bedding Course: Material placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow: Satisfactory soil imported from off-site location for use as fill or backfill.
- E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- F. Embedment: Backfill placed around the pipe in the trench consisting of the bedding, haunching, and the initial backfill.
- G. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by the Architect. Authorized additional excavation and replacement material will be paid for according to contract provisions for changes in the Work.
- H. Fill: Soil materials used to raise existing grades.
- I. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. for bulk excavation or 3/4 cu. yd. for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:
1. Excavation of Footings, Trenches, and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch wide, maximum, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,090 lbf and stick-crowd force of not less than 18,650 lbf; measured according to SAE J-1179.
 2. Bulk Excavation: Late-model, track-mounted loader; rated at not less than 210-hp flywheel power and developing a minimum of 48,510-lbf breakout force with a general-purpose bare bucket; measured according to SAE J-732.
- J. Foundation: Subgrade below bedding material. Typically undisturbed earth unless soil is unsuitable, soft, or mucky.
- K. Haunching: Material placed on top of the bedding material in the trench from the flow line of the pipe to the spring line of the pipe including material to support the sides of pipe.
- L. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

- M. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- N. Subgrade (aka: Final Subgrade or Rough Grade): Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- O. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated.
- P. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Each type of plastic warning tape.
 - 2. Geotextiles.
 - 3. Controlled low-strength material, including design mixture.
- B. Qualification Data: For qualified testing agency
- C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
 - 1. Classification according to ASTM D 2487 of each on-site or off-site borrow soil material proposed for fill and backfill.
 - 4. Laboratory compaction curve (Standard Proctor) according to ASTM D 698 (AASHTO T99) for each on-site or off-site borrow soil material proposed for fill and backfill.
- D. Submit all purchased items that will be left on site and become the owner's property after construction.
 - 1. Gradation for Granular bedding material.
 - 2. Warning tape
- E. As-Built Survey: Once the rough grading of the FMS project portion of the site (east of delineation line noted on plan sheet C2.0) is completed as specified in the bid documents, the contractor shall hire a licensed surveyor to complete an as-built survey of that portion in its entirety. It is the surveyor's responsibility to compare the surface with the rough grade requirements of the plans for elevation, slopes, etc. and certify that the contractor has completed the rough grading in accordance with the plan requirements.
 - 1. Should the survey show deficient areas, it is the contractor's responsibility to rework the deficient areas until the surveyor can certify the as-built survey.
 - 2. A copy of the As-Built survey and the certification document shall be submitted to the Engineer prior to Owner acceptance of that work.

1.5 QUALITY ASSURANCE

- A. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented according to ASTM D 3740 and ASTM E 548.
1. Geotechnical Testing Agency will be retained and paid for by the Contractor.

1.6 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated:
1. Notify Architect not less than two days in advance of proposed utility interruptions.
 2. Do not proceed with utility interruptions without Architect's written permission.
 3. Contact utility-locator service for area where Project is located before excavating.
- B. 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.

PART 2- PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: As approved by the Geotechnical Engineer and free of rock or gravel larger than 3 inches in any dimension, debris, organic matter, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: As identified by the Geotechnical Engineer or not meeting satisfactory soil conditions.
1. Unsatisfactory soils also include satisfactory soils not maintained within the specified moisture content at time of compaction.
- D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- E. Base Course: ASTM C-33 Size No. 57 Aggregate or similar.
1. Gradation:

<u>Sieve Size</u>	<u>% Retained (by dry wt.)</u>
1-1/2"	0
1"	0-5
1/2"	40-75
#4	90-100
#8	100
 2. Reinforcement: BX100 Geogrid by Tensar Corporation or approved equal.
 - a. Placed directly on top of the subgrade layer prior to placement of base course.

- b. Install per manufacturer's recommendations.
- F. Backfill and Fill: Satisfactory soil materials.
- G. Engineered Fill: Existing or substituted soils that have been modified for moisture content, compaction liquid limit, plasticity index or plastic limit. Engineered Fill to include low volume change material as defined within this section.
- 1. The upper 24" of material directly below the floor slabs (excluding granular leveling course or capillary moisture break) shall consist of a Low Volume Change (LVC) layer.
 - 2. The materials within 30" of the bottom of the LVC layer shall be evaluated just prior to placement of additional fill for moisture content. Should the materials be drier than 3 percentage points wet of optimum moisture content (ASTM D-698), the materials shall be removed and replaced uniformly with moisture content at least 3 percentage points wet of optimum. The replacement should occur in no more than 9" loose thickness and compacted to at least 95% but not more than 100% of the material's maximum dry density (ASTM D-698).
 - a. The minimum moisture content at which the engineered fill below the LVC layer should be placed will be as follows:
 - 1) Cohesive soils with a plasticity index (PI) greater than 25 should be placed at a moisture content of at least 3 percentage points wet of optimum moisture content
 - 2) Cohesive soils with a PI greater than 20 should be placed at a moisture content of at least 2 percentage points wet of optimum moisture content.
 - 3) Cohesive soils with a PI less than 20 should be placed at a moisture content above their optimum moisture content.
 - 4) Granular soils should be placed at a workable moisture content.
 - b. In locations where moisture conditioning is not required, the upper 6" of exposed subgrade shall be scarified and recompactd to at least 95% of the material's maximum dry density at moisture contents at least 3 percentage points wet of optimum.
 - 3. All engineered fill sections should extend at least 5 feet (horizontally) outside of the edges of the building footprint.
- H. Bedding Course:
- 1. Storm Sewer or Sanitary Sewer:
 - a. Type 1 Pipe Bedding Material: Crushed Rock conforming to ASTM C-33, Gradation No. 67
 - b. Type 2 Pipe Bedding Material: Sand-gravel mix for Type UD-2 underdrain aggregate.
 - c. Type 3 Pipe Bedding Material: May be the same as Type 1 of 2 at the option of the contractor, or it may be a pit-run sand, or it may be select earth material which is free from stones larger than two inches in the longest dimension or trash and contains proper moisture content for compaction.
 - 2. Waterline Pipe: Consists of sand placed from six inches (6") under the barrel of the pipe extending to a level twelve inches (12") above the top of the pipe.
- I. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.
- J. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No. 4 sieve.
- K. Sand: ASTM C-33; clean washed sand with one-hundred percent (100%) passing the 3/4" sieve, not more than twenty-five percent (25%) retained on a No. 4 sieve and not more than ten percent (10%) passing the No. 200 sieve.

- L. Low Volume Change (LVC) Material: Materials that have a liquid limit (LL) less than 40 and a plasticity index (PI) of at least 5 but less than 15. These materials may include granular soils (such as silty gravel, limestone/concrete screenings or clayey sand) or silty, sandy or lean clays.
 - 1. Laboratory testing should be done on all prospective LVC materials to confirm their suitability prior to use.
 - 2. Contractor may need to perform "wetting maintenance" in order to maintain the required above the optimum moisture content in the cohesive LVC material until construction of the floors.
 - 3. LVC material should extend at least 5 feet beyond the edges of the proposed building.
- M. Borrow Areas: Borrow areas provided by the contractor shall be approved by the Engineer as to suitability of material and location. Special care shall be taken in this approval to minimize the increase of siltation and turbidity of streams, lakes, and reservoirs and to avoid interference with the movement of migratory fish. Areas which, in the opinion of the engineer, leave an unsightly appearance to the Project will not be approved. All borrow sites must also be approved by the State of Missouri Department of Natural Resources.
- N. Topsoil: Topsoil material shall be stripped (approximately 3" thick, see boring logs in Geotechnical Report) and stockpiled for use in final grading of the project. Any additional Topsoil needed for final grading of the project shall be previously stripped from the site or provided by the contractor at no additional cost.

2.2 CONTROLLED LOW-STRENGTH MATERIAL

- A. Controlled Low Strength Material: Low-Density, self-compacting, flowable concrete material as follows:
 - 1. Portland Cement: ASTM C 150, Type I or II.
 - 2. Fly Ash: ASTM C 618, Class C or F.
 - 3. Normal Weight Aggregate: Fine Aggregate as defined in the Missouri Standard Specifications for Highway Construction, 1999, Section 1000, Subsection 1002.
 - 4. Foaming Agent: ASTM C 869.
 - 5. Water: ASTM C 94/C 94M.
 - 6. Air Entraining Admixture: ASTM C 260.
- B. Produce low density, controlled low-strength material with the following physical properties:
 - 1. As-Cast unit Weight: 120 lb./cu.ft. maximum at point of placement, when tested according to ASTM C 138/C 138M.
 - 2. Compressive strength: 80 psi, when tested according to ASTM C 495.

2.3 ACCESSORIES

- A. Silt Fence Fabric: Fine mesh material specifically designed to retain soil run-off, while maintaining surface drainage.
- B. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, minimum 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:
 - 1. Red: Electric
 - 2. Yellow: Gas, oil, steam, and dangerous materials.
 - 3. Orange: Telephone and other communications.
 - 4. Blue: Water systems.

5. Green: Sewer systems/Force mains

PART 3- EXECUTION

3.1 LINES AND GRADES

- C. Lay pipes to lines and grades indicated on Drawings.
 1. Engineer reserves right to make changes in lines, grades, and depths of utilities when changes are required for Project conditions.
- D. Use laser-beam instrument with qualified operator to establish lines and grades on all pipe lines that will transmit fluid by gravity flow with a slope less than one percent (1.00%).
- E. Maintain grade alignment of other pipelines using string line parallel with grade line and vertically above centerline of pipe.
 1. Install batter boards spanning trench, rigidly anchored to posts driven into ground on both sides of trench.
 2. Determine elevation and position of string line from elevation and position of off-set points or stakes located along pipe route.

3.2 PREPARATION

- A. Verify field measurements prior to fabrication.
- B. Call Local Utility Line Information service not less than five working days before performing Work.
 1. Request underground utilities to be located and marked within and surrounding construction areas.
- C. Identify required lines, levels, contours, and datum locations.
- D. Protect plant life, lawns, and other features remaining as portion of final landscaping.
- E. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- F. Maintain and protect above and below grade utilities indicated to remain.
- G. Establish temporary traffic control and/or detours when trenching across roadways or streets. Relocate controls and reroute traffic as required during progress of Work.
- H. Protect existing structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- I. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions and deleterious materials from ground surface is specified in Division 31 Section "Site Clearing."
- J. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.

- K. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.
- L. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
 - 1. Temporary Erosion Control methods and materials shall be in accordance with the Stormwater Pollution Prevention Plans (SWPP Plans) within the project documents and the City of St. Joseph Standard Specifications.
- M. Vegetation, topsoil, fill, existing structures and other loose, soft or otherwise unsuitable material should be removed from the planned paved areas at the on-set of construction. The procedures and recommendations in the Geotechnical Engineering Report shall be used. In addition to undercutting and moisture conditioning the existing site soils or replacing unsuitable existing soils (as required), all materials within the upper 24 inches of building floor slab subgrade level shall consist of low volume change material.
- N. Strip all material classified as topsoil and miscellaneous fill in all disturbed areas; stripping shall be through the topsoil vegetation (or root zone).
 - 1. Strip at least the upper 3" of existing materials.
- O. Stockpile topsoil on-site for future use for finish grading.
 - 1. The stockpile shall be surrounded with silt fence and temporarily seeded to prevent excessive erosion.

3.3 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. There is an existing underground contamination flume below a portion of the site that was identified by Terracon Consultants, Inc. The contractor shall identify the level of contamination within any groundwater encountered during construction, through an independent testing agency paid for by the contractor, prior to dewatering. Contaminated groundwater shall be pumped either to a sanitary sewer manhole or pumped into approved tanker trucks, removed from site and disposed of in an approved manner.
- C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
 - 2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.4 EXPLOSIVES

- A. Explosives: Do not use explosives.

3.5 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil

materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
 1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required grades to leave solid base to receive other work.
 2. Pile Foundations: Stop excavations 6 to 12 inches above bottom of pile cap before piles are placed. After piles have been driven, remove loose and disturbed material. Excavate to final grade, leaving solid base to receive concrete pile caps.
 3. Excavation for Underground Tanks, Basins and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.
- B. Remove all fill material from within and at least 5 feet beyond the building footprint. Proofroll the exposed subgrades with a loaded tandem-axle dump truck or other heavy rubber-tired construction equipment weighing at least 20 tons to locate any zones that are soft or unstable.
 1. Remove and replace any locations where rutting or pumping occurs during proofrolling or aerate/rework and re-compact in place to the specifications for Engineered Fill.

3.8 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Architect.
 2. Fill unauthorized excavations under other construction or utility pipe as directed by Engineer.

3.9 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow materials and satisfactory excavated soil materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover or temporarily seed stockpiles to prevent windblown dust.
 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.
 2. Place silt fence around stockpiles to prevent excessive erosion and sediment loss.

3.10 EXCAVATION FOR UTILITY TRENCHES

- A. **TRENCHING EXCAVATION:** The trench shall be excavated, true to line and grade as shown on the Plans or established by the Engineer. The Contractor shall perform all excavation of every description and of whatever substances encountered to the depths indicated on the Plans or as otherwise specified. During excavation, material suitable for backfilling shall be piled in an orderly manner a sufficient distance from the banks of the trench to avoid over-loading and to prevent slides or cave-ins. Such grading shall be done as may be necessary to prevent surface water from flowing into trenches or other excavations, and to maintain the flow of water in natural watercourses on or adjacent to the site. Any water accumulating in trenches or other excavations shall be removed by pumping or by other approved methods as specified elsewhere (see Section 3.3 – Dewatering). Unless otherwise indicated or authorized, excavation shall be by open cut.
1. Do not interfere with 45 degree bearing splay of foundations.
 3. All excavated materials not required or suitable for backfill shall be removed and disposed of off the site, by and at the expense of the Contractor.
 4. The Contractor shall not open more trench in advance of pipe laying than is necessary. Two hundred (200) feet will be the maximum length of open trench allowed on any line under construction. All open trenches shall be adequately protected.
 5. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
- B. **TRENCH BOTTOMS:** Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade. Excavate to allow for bedding material where required.
- C. **LIMITING TRENCH WIDTHS AND PIPE CLEARANCES:** Trenches shall be excavated to a width that will provide adequate working space and pipe clearances for proper pipe installation, jointing, bedding, and initial backfill operations.
1. Trench walls shall be vertical from bottom of trench to twelve (12) inches above the top of pipe. Above that point, trench wall shall be sloped as required to meet safety standards and all pertinent OSHA Regulations. When Project conditions do not permit safe trench wall slopes, provide sheeting and shoring to protect excavation as specified in this section.
- D. **UNAUTHORIZED TRENCH WIDTHS:** Where, for any reason, the width of the lower portion of the trench as excavated at any point exceeds the maximum specified above, either pipe of adequate design, total concrete pipe encasement, additional granular embedment or arch concrete encasements as required by loading conditions and as determined by the Engineer (at the Contractor's expense) shall be furnished and installed by and at the expense of the Contractor. The determination of necessary pipe, special embedment, or arch concrete encasement shall be based on a pipe strength equal to the minimum three-edge bearing ultimate strength stipulated in the governing pipe specifications for the size and kind of pipe involved with a safety factor of 65. Trench loadings will be based on saturated backfill weighing 120 (one hundred twenty) pounds per cubic foot with suitable allowance for truck or other live loads where required.
1. Correct areas over excavated areas with compacted backfill as specified for authorized excavation or replace with fill concrete as directed by Engineer.
- E. **Embankment or fill:** When pipe is to be installed in embankment or fill, the embankment shall be constructed in accordance with APWA section 2102.6 and shall be built up to a plane at least 18 inches above the top of the pipe prior to the excavation of the sewer trench.

- F. **MECHANICAL EXCAVATION:** The use of mechanical equipment will not be permitted in locations where its operation would cause damage to trees, buildings, culverts, or other existing property, utilities, or structures above or below ground; in all such locations, hand excavating tools and methods shall be used.
1. Mechanical equipment used for trench excavation shall be of a type, design, and construction, and shall be so operated, that the control of the rough trench excavation bottom elevation is accurate and positive at all times, that uniform trench widths and vertical side walls are obtained at least from an elevation one foot above the top of the installed pipe to the bottom of the trench and that the trench alignment is such that the pipe when accurately laid to specified alignment will be centered in the trench with adequate clearance between the pipe and side walls of the trench as excavated at all points. Undercutting of the sidewall to obtain such clearance will not be permitted.
 2. All mechanical trenching equipment, its operating condition, and the manner of its operations, shall be subject at all times to the approval of the Engineer.
- G. **BLASTING:** The use of explosives is not allowed.
- H. **BELL HOLES:** Excavation for bell holes for the various types of joints to be made, excavation for assembling and bolting mechanical joints or couplings, excavation in trench banks to provide additional working space, and any other excavation outside of rough excavation limits which may be required for pipe jointing operations shall be performed prior to the installation of the specified bedding material below pipe subgrade elevations to prevent contamination of the bedding material.
1. Bell holes for mechanical joint pipe shall provide adequate clearance for the tools and methods used in installing and bolting the joints.
 2. Bell holes for boltless gasketed joint pipe shall be excavated to provide at least one-inch clearance between the pipe bell and the bottom of the bell hole.
 3. Excavations for the installation of Dresser type couplings on steel pipe shall have a length of twenty-six (26) inches parallel to the center line of the pipe, shall be centered on the middle of the joint, and shall provide a clearance of two (2) feet on the sides of an eighteen (18) inches below the bottom of the pipe.
 4. Regardless of the type of joint, all excavations shall be of sufficient size and depth that the joints can be properly made and so that no part of the pipe bell, will be in contact with the trench bottom or pipe bedding thereon.
- I. **DEWATERING OF TRENCHES:** Pipe trenches shall be kept free from water during excavation, fine grading, pipe laying and jointing, and pipe encasement operations in an adequate and acceptable manner. Where the trench bottom is mucky or otherwise unstable because of the presence of ground water, and in all cases where the static ground water elevation is above the bottom of any trench or bell hole excavation, such ground water shall be lowered by means of well point and pumps or by other means acceptable to the Engineer, to the extent necessary to keep the trench free from water and the trench bottom stable at all times when work within the trench is in progress. The disposal of waste water from trench dewatering operations shall be subject to the approval of the Engineer at all times; such waste water shall be conducted to existing drainage ditches, channels, or drains. Surface water shall be diverted to prevent it from entering trenches.
1. See additional Dewatering instructions in Section 3.3 – Dewatering.
- J. **CUTTING CONCRETE PAVEMENT AND WALKS:** Pipe lines constructed under paved roadways may be constructed by open cut trenching except at specific locations designated on the Plans where they shall be placed by boring, or a combination of boring and jacking. Brick pavement, concrete pavement and all types of concrete base pavement, may be removed or cut only where, in the manner, and to the extent specified herein or authorized by the Engineer. Cuts shall be no larger than necessary to provide adequate working space for proper installation of

pipe and pipe line appurtenances. The cutting of pavements along each side of trenches and at structures shall saw cut. The saw cut shall be full depth of the pavement. Concrete pavement and walks shall be placed to existing joints.

1. Concrete pavement, brick and concrete base pavement over trenches excavated for pipe lines shall be removed to a width not less than twelve four (24) inches wider than the width of the trench at the pavement subgrade, which trench width shall not exceed the minimum permissible trench width for the size and type of pipe which is to be installed in the trench by more than twelve (12) inches. The trench width at the trench bottom shall not be greater than at the top and no under-cutting will be permitted. A shoulder not less than twelve (12) inches in width at any point shall be left between the cut edge of the pavement and the top edge of the trench. Pavement cuts shall be made to and between straight lines that, unless otherwise required, shall be parallel to the centerline of the trench.
 2. Where the line of trench parallels the length of concrete walks and the trench location is all or partially under the walk, then the entire walk shall be removed and replaced. Crossings not more than eight (8) feet in length shall be accomplished by tunneling where the line of trench crosses concrete walks, curbs or gutters with approval of the engineer. If necessary to remove concrete curbs, gutters or walks, they shall be replaced to and between existing joints.
- K. UNPAVED ROAD CROSSINGS: Unpaved roads, driveways or streets may be crossed by trenching unless otherwise noted on the Plans. The Contractor shall install suitable barricades and lights at open trenches and take any precautions necessary to protect the public from damage and as required by the Owner. The Contractor will be financially responsible for any damage or suits arising from said crossings and shall save and hold harmless the Owner and the Engineer from any claims arising from this construction. The surface shall be replaced to permit prompt opening to traffic. The Contractor shall arrange his work to insure that streets, driveways, and roads be closed no longer than necessary for construction operations. Surfacing of unpaved streets, alleys, driveways and other traveled ways shall match existing surface depth and type of surface material.
- L. EARTH EXCAVATION BELOW PIPE SUBGRADE: Pipe trenches shall be excavated below pipe subgrade elevations as shown on the Plans to provide for the installation of pipe bedding material as specified hereinafter.
- M. PIPE CLEARANCE IN ROCK: Where rock is encountered in excavating and where it is necessary to place pipe in rock excavation, the rock shall be removed to provide a minimum clearance, for the size of the pipe being laid as set forth in the following table:

<u>Size of Pipe</u>	<u>Below Pipe</u>	<u>MINIMUM CLEARANCE</u>	
		<u>At Side of Pipe</u>	
24" and smaller	6"	4"	
24" to 36"	9"	6"	
42" and larger	12"	6"	

1. The clearance figures given in the above table are minimum clearances from the closest projection of the rock to the outside edge of the pipe, and are not average figures. All material removed from the trench in order to provide the above-specified clearance shall be replaced below and at the sides of the pipe with approved backfill material. All replacement materials specified shall be furnished and installed by and at the expense of the Contractor.
- N. TRENCH BOTTOM STABILIZATION: Trench bottoms which become soft, mucky, or otherwise unstable during construction operations shall be stabilized, by and at the expense of the Contractor, with one or more layers of crushed rock or other suitable material, where and as

necessary to provide a firm and stable base for granular pipe bedding material. Not more than half-inch depth of mud or muck shall be allowed to remain on the stabilized trench bottom when the granular fill pipe foundation material is installed.

- O. ARTIFICIAL FOUNDATIONS IN TRENCHES: Whenever so ordered by the Engineer, the Contractor shall excavate to such depth below grade as the Engineer may direct and the trench bottom shall be brought to grade with such material as the Engineer may order installed. All timber, concrete foundations, wooden inverts, pipes, posts, stringers, and/or saddles, made necessary by quicksand or other treacherous soil, shall be installed as directed by the Engineer. Compensation for extra excavation, timber, concrete, or other foundations, except where provided by Contract unit prices, shall be made in subsidiary to other bid items in the Contract.

3.11 SHEETING AND SHORING

- A. TRENCH BRACING AND SHEETING: Except where trench banks are cut on a stable slope to prevent caving or sliding, trenches shall be properly and substantially braced, and sheeted if and where necessary, to prevent caving or sliding and to provide adequate protection to workmen and to the pipe line during and after the construction thereof. Sheeting shall not be pulled until after the initial backfill is complete and then the space left from the sheeting shall be filled immediately and the backfill recompacted.
1. Fill voids with approved backfill material while shoring and bracing, and as sheeting is removed.
 2. Where sheeting is left in place, such sheeting shall not be braced against the pipe, but shall be supported by stakes driven into the trench bottom on each side of the pipe and with the tops of the stakes supported by cross braces above the top of the pipe or by other means, approved by the Engineer, which will not result in the application of concentrated loads or horizontal thrusts on the pipe. Cross braces installed above the pipe for the purpose of supporting sheeting in the bottom of the trench may be removed after the specified pipe embedment has been completed beyond the point of cross brace removal.
 3. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.
 4. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

3.12 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
1. Proofroll exposed subgrades (under independent geotechnical agency supervision) with a loaded tandem-axle dump truck or other heavy, rubber tired construction equipment weighing at least 20 tons. Any unstable or soft zones exhibiting excessive pumping or rutting shall be removed and replaced or aerated/reworked and recompacted in place to the specifications for engineered fill.
 2. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing and perimeter installation.
 3. Surveying locations of underground utilities for Record Documents.
 4. Testing and inspecting underground utilities.
 5. Removing concrete formwork.
 6. Removing trash and debris.
 7. Removing temporary shoring, bracing and sheeting.
 8. Installing permanent or temporary horizontal bracing on horizontally supported walls.

- B. Backfill placed within building areas and in areas to be paved should consist of approved materials, which are free of organic matter and debris.
- C. Place backfill on subgrades free of mud, frost, snow or ice.
- D. Materials within 18 inches of the building floor slab subgrade level (excluding 4" granular leveling course) should be a select, low volume change (LVC) material (see Low Volume Change Materials in Section 2.1-Soil Materials)
- E. The contractor shall evaluate the material within at least 30 inches of the bottom of the LVC layer just prior to placing any additional fill. Where the native materials within this zone at the start of construction are drier than 3 percentage points wet of the optimum moisture content, as determined by ASTM D-698, the materials shall be corrected (See Engineered Fill in Section 2.1-Soil Materials) or Section 3.14-Approval of Subgrade

3.13 TRENCH BACKFILLING

- A. TRENCH BACKFILL: The kinds of backfill materials to be used and the methods of placing and compaction shall conform to the requirements shown on the Plans and as described below. Employ placement method that does not disturb or damage foundation perimeter drainage and utilities in trench.
 - 1. After each pipe has been graded, aligned and placed in final position on the bedding material, and shoved home, sufficient pipe embedment material shall be deposited and compacted under and around each side of the pipe and back of the bell or end thereof to firmly hold and maintain the pipe in proper position and alignment during subsequent pipe jointing, embedment and backfilling operations.
 - 2. Pipe embedment material, in each case, shall be deposited in the trench in such manner that it is scattered along the sides of the pipe and not dropped in compacted masses. In addition, such material shall be deposited, and compacted where required, uniformly and simultaneously on each side of the pipe in order to prevent lateral displacement of the pipe.
 - 3. Drainage maintenance: Backfilling of trenches for pipe installed beneath and/or across roadways, driveways, walks and other traffic ways adjacent to drainage ditches and water courses shall not be done prior to the completion of backfilling to the original ground surface of the trench on the upstream side of such trafficway in order to prevent the impounding of water at any point after the pipe has been laid, and all necessary bridges and other temporary structures required to maintain traffic across such unfilled trenches shall be constructed and maintained. Backfilling shall be done in such a manner that water will not accumulate in unfilled or partially filled trenches. All material deposited in roadway ditches or other water courses crossed by the line of trench shall be removed immediately after backfilling is completed and the section, grades and contours of such ditches or water courses restored to their original condition, in order that surface drainage will be obstructed no longer than necessary.
 - 4. Protection of trench backfill in drainage courses: Where trenches are constructed in or across roadway ditches or other watercourses, the backfill shall be protected from surface erosion by adequate means.
 - 5. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
 - 6. Backfill trenches excavated under footings and within 18 inches (450 mm) of bottom of footings; fill with concrete to elevation of bottom of footings.
 - 7. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.
 - 8. Coordinate backfilling with utilities testing.
 - 9. Place and compact final backfill of satisfactory soil material to final subgrade.

10. Install warning tape directly above utilities, 12 inches (min.) - 30 inches (max.) below finished grade.

B. Embankment or fill: When pipe is to be installed in embankment or fill, the embankment shall be constructed in accordance with APWA section 2102.6 and shall be built up to a plane at least 18 inches above the top of the pipe prior to the excavation of the sewer trench.

C. BACKFILL MATERIALS AND PLACEMENT

1. Bedding Course:

a. Storm Sewer or Sanitary Sewer:

- i. Type 1 Pipe Bedding Material: Crushed Rock conforming to ASTM C-33, Gradation No. 67
- ii. Type 2 Pipe Bedding Material: Sand-gravel mix for Type UD-2 underdrain aggregate.
- iii. Type 3 Pipe Bedding Material: May be the same as Type 1 or 2 at the option of the contractor, or it may be a pit-run sand, or it may be select earth material which is free from stones larger than two inches in the longest dimension or trash and contains proper moisture content for compaction.

b. Waterline Pipe: Consists of sand placed from six inches (6") under the barrel of the pipe extending to a level twelve inches (12") above the top of the pipe.

2. Pipe Embedment and Backfill

a. Sanitary/Storm Pipe:

- i. Rigid Pipe: Bedding course shall consist of Type 1 or 2 pipe bedding material under the barrel of the pipe extending up to a level equal to one-sixth (1/6) of the outside pipe diameter. Type 3 pipe bedding material shall be used from this level to a level twelve inches (12") above the top of the pipe.
- ii. Flexible Pipe: Bedding course shall consist of Type 1 or 2 pipe bedding material under the barrel of the pipe extending up to a level twelve inches (12") above the top of the pipe.
- iii. Semi-Rigid Pipe: Bedding course shall consist of Type 1 or 2 pipe bedding material under the barrel of the pipe extending up to a level equal to one-half (1/2) of the outside pipe diameter. Type 3 pipe bedding material shall be used from this level to a level twelve inches (12") above the top of the pipe.

b. Waterline Pipe:

- i. Bedding course for waterline pipe shall consist of sand placed from six inches (6") under the barrel of the pipe extending to a level twelve inches (12") above the top of the pipe.

3. Final Backfill:

- a. All final backfill under building or paved areas shall be select backfill.
- b. The top portion of backfill beneath established sodded areas shall be finished with not less than six (6) inches of topsoil.
- c. Backfill trenches to contours and elevations with unfrozen fill materials.
- d. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
- e. Do not leave more than 50 feet of trench open at end of working day.
- f. Place fill material in continuous layers and compact in accordance with COMPACTION SECTION.
- g. Protect open trench to prevent danger to the public.

- D. UNSUITABLE BACKFILL MATERIAL: No material shall be used for trench backfill which contains rocks or clogs greater than two (2) inches in any dimension, frozen material, debris, junk, or organic material. Such material shall be removed from the backfill and deposited at the direction of the Engineer.
- E. DISPOSAL OF EXCESS EXCAVATED MATERIALS: Except as otherwise permitted, all excess excavated materials shall be disposed of away from the work and at a site approved by the Engineer.
1. Broken concrete and other coarse debris resulting from pavement or sidewalk removal, excavated rock in excess of the amount permitted to be and actually installed in trench backfill, junk and debris encountered in excavation work, and other similar waste materials shall be disposed of away from the site of the work and at a site approved by the Engineer.
 2. The disposal of waste and excess excavated materials, including all hauling, handling, and spoil bank leveling and surfacing shall be a subsidiary obligation of the Contractor and the full cost thereof shall be considered as being included in and fully covered by other items in the contract.
- F. PROTECTION OF TREES AND SHRUBBERY: No trees shall be removed except where their removal is shown on the Plans or is authorized by the Engineer. Main tree roots shall not be cut except where they fall within the area to be occupied by the pipe. Excavation shall be done by hand where necessary to prevent injury to roots or trees. Trees that are left standing shall be adequately protected from permanent damage by reason of construction operations. Trimming of standing trees where required shall be as directed by the Engineer. All shrubbery outside of the construction limits, which is damaged or removed by the Contractor, shall be replaced under the direction of and to the satisfaction of the Owner, by and at the expense of the Contractor.
- G. INTERRUPTION OF TRAFFIC: Interruption to through traffic on streets and roads will be kept to a very minimum and provisions shall be made to permit local traffic to serve residences in the vicinity of the work at all times.
- H. REMOVAL AND REINSTALLATION OF ITEMS: Street signs, street stop signs, mail boxes and other existing items noted on the Plans or found within construction limits shall without damage be removed, stored, and reinstalled in a condition comparable to pre-existing condition prior to construction. No separate payment will be made for those items but shall be considered subsidiary to other pay items in the Proposal.

3.14 APPROVAL OF SUBGRADE

- A. Notify Geotechnical Engineer when excavations have reached required subgrade. This includes within building area prior to placement of all fill materials.
- B. If Geotechnical Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof roll subgrade beneath building slabs and pavements with a tandem-axle dump truck (with geotechnical engineer present) to identify soft pockets and areas of excess yielding. Do not proof roll wet or saturated subgrades.
1. Tandem-axle truck shall be a minimum of 20 tons gross weight.
- D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

- E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Geotechnical Engineer. In areas where reconstruction or reworking of the subgrade is required due to unstable conditions, unsuitable soils, or as indicated on the drawings, the Contractor shall undercut the area to a stable and firm strata and backfill as directed by the Geotechnical Engineer. Backfill shall be accomplished in not more than 9-inch lifts with soil meeting the requirements of satisfactory material and compacted as noted below. The contractor must meet the following density and moisture requirements:
1. Satisfactory soils:
 - a. Compacted to at least 95% but not more than 100% of standard proctor maximum density. (ASTM D-698)
 - b. Moisture content is 0 to 3% above optimum. (ASTM D-698)
 2. Paved Areas: Upper 8 inches of exposed subgrade (prior to final compacted subgrade layer identified in the pavement sections see Subsection 3.16.G below) and all additional fill
 - a. Compacted to at least 95% of standard proctor maximum density (ASTM D-698)
 - b. Above optimum moisture content (ASTM D-698).
- F. The upper 24" of material directly below the floor slabs (excluding 4" granular leveling course or 6" capillary moisture break) shall consist of a Low Volume Change (LVC) layer.
- a. The upper 6 inches of the LVC layer shall be ASTM C-33 Size No. 57 aggregate or similar, crushed limestone/concrete screenings or asphalt millings.
 - b. LVC layer shall extend at least 5' horizontally outside of the building footprint.
- G. The materials within 30" of the bottom of the LVC layer shall be evaluated just prior to placement of additional fill for moisture content. Should the materials be drier than 3 percentage points wet of optimum moisture content (ASTM D-698), the materials shall be removed and replaced uniformly with moisture content at least 3 percentage points wet of optimum. The replacement should occur in no more than 9" loose thickness and compacted to at least 95% but not more than 100% of the material's maximum dry density (ASTM D-698).
1. The minimum moisture content at which the engineered fill below the LVC layer should be placed will be as follows:
 - a. Cohesive soils with a plasticity index (PI) greater than 25 should be placed at a moisture content of at least 3 percentage points wet of optimum moisture content
 - b. Cohesive soils with a PI greater than 20 should be placed at a moisture content of at least 2 percentage points wet of optimum moisture content.
 - c. Cohesive soils with a PI less than 20 should be placed at a moisture content above their optimum moisture content.
 - d. Granular soils should be placed at a workable moisture content.
 2. In locations where moisture conditioning is not required, the upper 6" of exposed subgrade shall be scarified and recompact to at least 95% of the material's maximum dry density at moisture contents at least 3 percentage points wet of optimum.
 3. All engineered fill sections should extend at least 5 feet (horizontally) outside of the edges of the building footprint.
- H. If the soils do not have to be reworked or replaced, the top 6-inches of soil shall be reworked and compacted to 95 percent standard density and at least 0 percent to plus 3 percent of optimum moisture content.

3.15 SOIL FILL

- A. Preparation: Remove vegetation, topsoil, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface before placing fills.
- B. Plow, scarify, bench or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

- C. Prior to placing fill, the existing grade shall be inspected by the geotechnical engineer. All materials within 30 inches of the bottom of the low volume change material must be evaluated for moisture content and stability. If the soils are satisfactory soils drier than 0 percent to 3 percent wet of optimum (ASTM D-698) the soils will have to be reworked to be at least 0 percent to 3 percent above optimum (see Engineered Fill in Section 2.1 Soil Materials). The soils shall be reworked and replaced in not to exceed 9-inch lifts between 95 to 100 percent of standard density and at least 0 percent to plus 3 percent moisture. If the soils do not have to be reworked or replaced, the top 6-inches of soil shall be reworked and compacted to between 95 percent and 100 percent of standard density and at least 0 percent to 3 percent above optimum moisture content.
- D. Place and compact fill material as defined in Section 3.16 "Compaction of Backfills and Fills".
- E. Place and compact fill material in layers to required elevations as follows:
 - 1. Under grass and planted areas, use satisfactory soil material.
 - 2. Under walks and pavements, use satisfactory soil material.
 - 3. Under steps and ramps, use engineered fill.
 - 4. Under building slabs, use engineered fill
 - 5. Under footings and foundations, use engineered fill.
- F. Fill placed within building areas and in areas to be paved should consist of approved materials, which are free of organic matter and debris.
- G. Materials within 18 inches of the building floor slab subgrade level (excluding granular leveling coarse or capillary moisture break) should be a select, low volume change material.

3.16 MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to the requirements in this report.
 - 1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

3.17 COMPACTION OF UTILITY TRENCHES

- A. Prior to the placement of either structure backfill or trench backfill, a Standard Proctor Curve as determined by AASHTO T 99 (ASTM D 698) shall be obtained for each type of backfill material to be used.
 - 1. Proctor curves shall be obtained from soil samples selected by a certified testing laboratory from materials excavated by the Contractor.
 - 2. All costs associated with the selection of soil samples and performing the necessary tests to obtain the Proctor curves shall be paid by the Contractor.
 - 3. Selection of the correct Proctor curve for a particular backfill material shall also be done by the Contractor's certified testing laboratory.
 - 4. During backfill operations, soil density tests shall be taken by the Engineer or his representative. When results indicate that compaction does not meet the requirements of these Specifications, the material shall be removed and replaced or re-compacted as necessary to meet the specified requirements at no additional expense to the City. Additional tests shall be performed on re-compacted area to insure compliance with the requirements.

- B. Compacted backfill material shall be placed in layers and compacted by means of suitable equipment or by tamping with mechanical tampers or hand tampers.
 - 1. Place and densify embedment material by shovel slicing or vibrating and prepare embedment material so that the pipe will be true to line and grade after installation.
 - 2. After each pipe has been brought to grade, aligned, and placed in final position, deposit and densify by shovel slicing sufficient bedding material under the pipe haunches and on each side of the pipe to hold the pipe in proper position during subsequent pipe jointing, bedding, and backfilling operations. Place bedding material uniformly and simultaneously on each side of the pipe to prevent lateral displacement.

- C. Compacted backfill within two (2) feet of water valve boxes, wyes, and riser pipes shall be hand tamped. Compacted backfill within five (5) feet of sanitary sewer manholes and storm sewer structures shall be hand tamped. Ditch plugs at the pipe outlet and at interval points constructed to the limits specified herein shall be compacted to Type A compaction as specified in this section.

- D. All hand placed backfill shall be deposited and spread with hand tools in uniform layers not more than eight (8) inches in thickness on each side of the pipe and for the full width of the trench where above the pipe.

- E. **TYPE A COMPACTION:** Each layer shall be compacted to a density equal to or greater than 95% (ninety-five percent) maximum density. Each successive layer shall contain only the amount of material which will insure proper compaction, but in no case shall any layer be greater than eight (8) inches (loose measurement). The moisture content of the soil to be used for backfill shall be uniform and shall be within plus or minus two percentage points of optimum moisture for the soil.
 - 1. Type A Compaction shall be use under all pavements, sidewalks, curb and gutter, stairs, railings, and structures or buildings or as designated on the plans.
 - 2. The contractor shall certify that 98% (ninety-eight percent) compaction has been achieved. Results of tests performed shall be submitted to the Engineer.
 - 3. Testing frequency shall be at each compacted initial and final backfill layer at least one test for each 150 feet or less of trench length, but no fewer than two tests. per layer.
 - a. Additional testing shall be taken at the recommendation of the engineer or in areas where compaction of trench initial or final backfill is in question.
 - 4. Where applicable, Type A compaction shall begin and end a minimum of 1' behind the back of curb or edge of pavement on street or pavement crossings.
 - 5. The maximum density of the soil shall be determined by ASTM designation: D698. The test to determine the maximum density of the soils (Standard Proctor) shall be performed by an approved testing laboratory without cost to the Owner.
 - 6. Backfill shall be composed of selected excavated material or approved borrow material.
 - 7. Flowable Fill: A controlled low-strength material (flowable fill) may be substituted for Type A compaction. The materials used shall be the following in the approximate quantities per cubic yard:
 - a. These proportions may be field adjusted to provide a fill that readily flows around the pipe. The fill shall be placed on both sides of the pipe simultaneously so that both sides are kept approximately equal. The pipe shall be secured in place against floatation and

Cement	100 lbs./Type 1
Water	370 lbs.
Fine Aggregate	3,400 lbs., 100% smaller than half inch; 0 to 10% smaller than No. 200 sieve.

movement prior to placement of the fill to secure . The fill shall be placed to the bottom of the pavement to be placed over the trench.

- F. TYPE B COMPACTION: Type B Compaction shall be used in all other areas not requiring Type A compaction as stated in this specification or as designated in the plans.
1. Type B Compaction shall be placed in layers and compacted by means of suitable equipment or by tamping with mechanical tampers or hand tampers. Each layer shall be compacted to a density equal to or greater than 90% (ninety percent) maximum density. Each successive layer shall contain only the amount of material which will insure proper compaction, but in no case shall any layer be greater than eight (8) inches (loose measurement). The moisture content of the soil to be used for backfill shall be uniform and shall be within plus or minus two percentage points of optimum moisture for the soil.
 2. The Contractor shall certify that 90% (ninety percent) compaction has been achieved. Results of tests performed shall be submitted to the Engineer.
 3. Testing frequency shall be at each compacted initial and final backfill layer at least one test for each 50 linear feet of trench.
 - a. Additional testing shall be taken at the recommendation of the engineer or in areas where compaction of trench initial or final backfill is in question.

3.18 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place fill and backfill materials in layers not more than 9 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
 1. Backfill against structures shall be granular soils (extending out from the base of the wall at an angle of at least 45 degrees) or low plasticity soils.
- C. The upper 18" of material directly below the floor slabs (excluding 4" granular leveling course or capillary moisture break) shall consist of a Low Volume Change (LVC) layer.
 - a. The upper 6 inches of the LVC layer shall be ASTM C-33 Size No. 57 aggregate or similar, crushed limestone/concrete screenings or asphalt millings.
 - b. Soils shall be placed in not more than 9" loose thickness and compacted to at least 95% but not more than 100% of the maximum dry density.
 - c. LVC layer shall extend at least 5' horizontally outside of the building footprint.
- D. The materials within 30" of the bottom of the LVC layer shall be evaluated just prior to placement of additional fill for moisture content. Should the materials be drier than 3 percentage points wet of optimum moisture content (ASTM D-698), the materials shall be removed and replaced uniformly with moisture content at least 3 percentage points wet of optimum. The replacement should occur in no more than 9" loose thickness and compacted to at least 95% but not more than 100% of the material's maximum dry density (ASTM D-698).
 1. The minimum moisture content at which the engineered fill below the LVC layer should be placed will be as follows:
 - a. Cohesive soils with a plasticity index (PI) greater than 25 should be placed at a moisture content of at least 3 percentage points wet of optimum moisture content

- b. Cohesive soils with a PI greater than 20 should be placed at a moisture content of at least 2 percentage points wet of optimum moisture content.
 - c. Cohesive soils with a PI less than 20 should be placed at a moisture content above their optimum moisture content.
 - d. Granular soils should be placed at a workable moisture content.
2. In locations where moisture conditioning is not required, the upper 6” of exposed subgrade shall be scarified and re-compacted to at least 95% of the material’s maximum dry density at moisture contents at least 3 percentage points wet of optimum.
- E. All engineered fill sections should extend at least 5 feet (horizontally) outside of the edges of the building footprint.
- F. Compact soil to not less than the following percentages of maximum dry unit weight according to ASTM D 698:

<u>Subgrade Material</u>	<u>Density Requirements</u>	<u>Moisture Requirements</u>
Satisfactory soils	95 – 100 percent (ASTM D-698)	0 to +3 percent
Subgrade Preparation	95 – 100 percent (ASTM D-698)	0 to +3 percent
Low volume change	95 – 100 percent (ASTM D-698)	0 to +3 percent
Pavement Subgrade**	98 – 100 percent (ASTM D-698)	0 to +3 percent

** see additional info in sections below

- G. In areas to be paved, the upper 8” of native soil (after removal of vegetation/organic material and topsoil) shall be proofrolled as described in section 3.13.C. The upper 8” of the exposed subgrade shall be shall be compacted to at least 95% of the maximum dry density (ASTM D-698) and above optimum moisture content prior to placement of additional fill. All additional fill shall be placed in 9” loose thickness and compacted to at least 95% of maximum dry density and above optimum moisture content.
- 1. The final 8” of subgrade directly beneath flexible pavements shall be compacted to at least 98% of standard proctor maximum dry density.
 - 2. The final 18” of subgrade directly beneath rigid, concrete pavements and exterior slabs shall meet the requirements of Subsection D above (3.16.D)
- H. The exposed subgrade and each lift of compacted fill shall be tested, evaluated and reworked as necessary until approved by the geotechnical engineer prior to placement of additional fill.
- 1. Each lift of fill shall be tested for density and moisture content at a frequency of one test for every 2,500 square feet of compacted fill in the building areas and 5,000 square feet in the pavement areas.

3.19 STORM WATER POND LINERS

- A. In order to limit seepage from storm water wet pond(s), earthen liners of approved clay shall be placed as follows:
- 1. Construct an earthen liner along the bottom and sides of the wet pond to a thickness of 12 inches.
 - a. The 12 inch thick layer shall consist of approved fat clay soils with a plasticity index of at least 25, as indicated by laboratory Atterberg Limits tests of samples of the completed liner.

- b. The liner materials shall be free of organic and deleterious materials, with compacted lifts not to exceed 6 inches in thickness, adjusted in moisture content to between zero and 4 percentage points above the optimum moisture content and compacted to a minimum of 95% of the maximum dry density (ASTM D-698). The moisture content and compaction should be maintained in the earthen liner until after the initial fill of the wet pond.
 - c. Fill materials used to construct the embankment should be free of organic materials and debris and placed in lifts not to exceed 9" loose thickness and shall be compacted to at least 95% of the standard proctor maximum dry density at moisture contents within 2 percentage points of the optimum (ASTM D-698).
 2. During liner construction, field moisture and density testing and Atterberg Limits testing should be conducted to evaluate the suitability of the proposed liner materials. The exposed sub-grade and each lift of compacted fill shall be tested, evaluated and reworked as necessary until approved by the Geotechnical Engineer, prior to placement of additional lifts.
 - a. Each lift of fill shall be tested for density and moisture content at a frequency of at least one test per acre of compacted fill in the storm water wet pond areas.
 - b. The Contractor shall test the permeability of relatively undisturbed tube samples from the constructed liner.

3.20 GRADING

- A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 1. Provide a smooth transition between adjacent existing grades and new grades.
 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding.
 1. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.21 SUBBASE AND BASE COURSE

- A. Place subbase and base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase and base course under pavements and walks as follows:
 1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 2. Place base course material over subbase course under hot-mix asphalt pavement.
 3. Shape subbase and base course to required crown elevations and cross-slope grades.
 4. Place subbase and base course 6 inches or less in compacted thickness in a single layer.
 5. Place subbase and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.

6. Compact subbase and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

- C. Pavement Shoulders: Place shoulders along edges of subbase course and base course to prevent lateral movement. Construct shoulders at least 12 inches wide of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.22 DRAINAGE COURSE

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 2. Place drainage course 6 inches or less in compacted thickness in a single layer.
 3. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.23 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing as stated in section 1.5 QUALITY ASSURANCE.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
- C. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2,500 sq. ft. or less of building slab and 5,000 sq. ft. or less of pavement areas, but in no case fewer than three tests.
 2. Trench Backfill: At each compacted initial and final backfill layer at least one test for each 50 linear feet or less of trench length, but no fewer than two tests.
- D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.24 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace soil material to depth as directed by Geotechnical Engineer: reshape and re-compact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.25 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.
 - 1. Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 31 2000

Geotechnical Engineering Report

139th Security Forces Building
Panigot Road and 26th Road

St. Joseph, MO

November 21, 2013

Terracon Project No. 02135197

Prepared for:

HTK Architects
St. Joseph, MO

Prepared by:

Terracon Consultants, Inc.
Lenexa, KS

Offices Nationwide
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Terracon

Geotechnical ■ Environmental ■ Construction Materials ■ Facilities

November 21, 2013



HTK Architects, PA
2900 SW MacVicar Avenue
Topeka, KS 66611

Attn: Mr. Keith Blackburn, AIA
E: rkb@htkarchitects.net

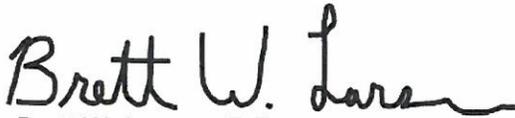
Re: Geotechnical Engineering Report
139th Security Forces Building
St. Joseph, MO
Terracon Project Number: 02135197

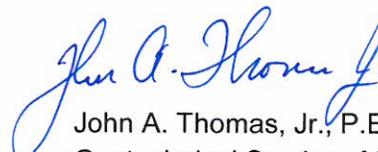
Dear Mr. Blackburn:

Terracon Consultants, Inc. (Terracon) has completed the geotechnical engineering services for the proposed 139th Security Forces Building in St. Joseph, MO. This study was performed in general accordance with our proposal number P02130783. This report presents the findings of the subsurface exploration and provides geotechnical recommendations relating to foundations and earthwork.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.


Brett W. Larsen, P.E.
Geotechnical Engineer


John A. Thomas, Jr., P.E.
Geotechnical Services Manager
MO: PE-2010008959



Enclosures
cc: 1 – Client (PDF)
1 – File

Terracon Consultants, Inc. 13910 W. 96th Terrace Lenexa, Kansas 66215
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Exhibit A-2	Boring Location Diagram
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Exhibit A-10	Field Exploration Description

APPENDIX B – SUPPORTING INFORMATION

Exhibit B-1	Laboratory Testing
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APPENDIX C – SUPPORTING DOCUMENTS

Exhibit C-1	General Notes
Exhibit C-2	Unified Soil Classification System

GEOTECHNICAL ENGINEERING REPORT
139TH SECURITY FORCES BUILDING
PANIGOT ROAD AND 26TH ROAD
ST. JOSEPH, MO
Terracon Project No. 02135197
November 21, 2013

1.0 INTRODUCTION

A geotechnical exploration has been performed for the proposed security forces building at Rosecrans Memorial Airport in St. Joseph, MO. Terracon performed six (6) borings at the site to depths ranging from approximately 10 to 40 feet below the existing ground surface. A site location plan, a boring location diagram and logs of the borings with laboratory data are included in Appendix A of this report.

The purpose of this report is to describe the subsurface conditions, present the test data and provide recommendations for design of the proposed structure, pavements, floor slabs, and general earthwork.

2.0 PROJECT INFORMATION

2.1 Project Description

Item	Description
Site layout	See Appendix A, Exhibit A-2: Boring Location Plan
Security Forces Building	A single-story, 9-600 square foot building is planned at a presently vacant lot on Rosecrans Memorial Airport.
Finished floor elevation (FFE)	Not provided
Maximum loads (considered by Terracon)	Columns: 100 kips Walls: 3 kips/foot
Pavements	A parking lot is planned to the north of the proposed building. The pavements will have a plan area of approximately 160 feet by 85 feet.
Grading	We understand that fills of up to 4 feet will be placed to develop site grading.
Below-grade areas	None planned.

2.2 Site Location and Description

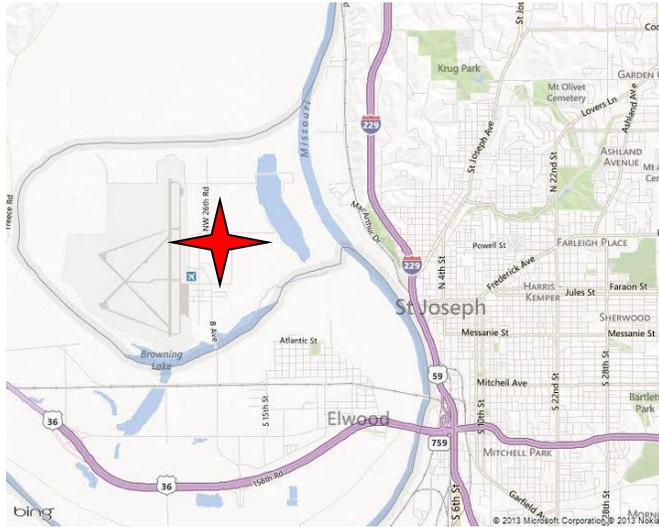


Figure 1. Site Location



Figure 2. Aerial of Site

Item	Description
Location	This project site is located at Rosecrans Memorial Airport in St. Joseph, MO, near the southeast corner of NW Panigot Road and 26 th Street Road.
Existing conditions	The site is undeveloped and bounded by paved roads. We anticipate that some fills may have been placed for construction of the roads.
Existing topography	Based on our boring elevations, the site is relatively flat with less than 3 feet of elevation change across the site.

3.0 SUBSURFACE CONDITIONS

3.1 Site Geology

Based on review of the 2002 Geologic Map of the St. Joseph area, the soils at the site are comprised of alluvial deposits, described as yellowish-brown, dark brown, grayish-brown, or dark gray silt, clay, and very fine sand which are poorly to well sorted and poorly to well stratified.

3.2 Typical Profile

Based on the results of the borings, subsurface conditions on the project site can be generalized as follows:

Stratum	Approximate Depth to Bottom of Stratum (feet)	Material Description	Consistency/ Density
1	8.5 to 28.5 feet	Fat clay, lean clay, and silt	Interbedded layers of clay and silt, medium stiff to hard
2	Not determined ¹	Sand	Brown to gray, loose to dense

1. Borings B-1 was terminated at a depth of 40 feet in sand. Other borings were terminated at depths noted on the attached borings logs in alluvial clays, silts, or sands at depths ranging from 10 to 20 feet.

Subsurface conditions encountered at the boring locations are indicated on the attached boring logs. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; in situ, the transition between materials may be gradual.

3.3 Groundwater

The borings were observed while drilling and after completion for the presence of groundwater. Groundwater was observed at Borings B-1, B-2, B-3, and B-4 at depths ranging from 12 to 15 feet during drilling or sampling of the boring. Groundwater was not observed in other borings. Long term observations in piezometers or observation wells sealed from influence of surface water are often required to define groundwater levels.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times may be higher or lower than the levels indicated on the boring logs.

4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

4.1 Geotechnical Considerations

Based on the results of the subsurface exploration, laboratory testing, and our analyses, it is our opinion that the proposed building addition can be supported on shallow foundations that bear on native clays, silts, or compacted engineered fill. Geotechnical considerations for this project also include:

- Swell potential
- Moisture sensitive soils

4.1.1 Swell Potential

High plasticity, clay soils were present on portions of the site. Clays are commonly referred to as “expansive” or “swelling” soils because they expand or swell as their moisture contents

increase. However, these soils also “contract” or “shrink” as their moisture contents decrease. Footings and floor slabs supported on expansive soils can move upward and downward significantly and such movements can result in distortion of, cracking in and cosmetic as well as structural damage to the structure. To reduce the risk related to expansive soils on this site, we recommend low volume change (LVC) materials be used to construct the subgrade beneath the grade-supported floor slabs of the buildings. The LVC fill layer should be at least 24 inches thick and should meet the LVC material criteria outlined in this report in section **4.2 Earthwork**.

Even with the use of an LVC layer, clay soils shrink and swell to some extent with normal variations in moisture content; some movements normally occur and should be expected and anticipated. Recommendations in this report are intended to reduce the potential for extreme movements and the resulting damage caused by the presence of expansive soils on this site, which experience moisture content variations within a normal range. Because weather related conditions (floods, droughts, sub-freezing temperatures, etc.) cannot be controlled, larger movements should still be expected if expansive soils become very wet or very dry.

4.1.2 Moisture Sensitive Soils

The alluvial deposits present at the site include lean clay, silt, and sand. Though our borings did not encounter exceedingly soft or wet soils, these soils are susceptible to disturbance from construction activity, particularly if the soil has a high natural moisture content or is wetted by surface water or seepage. Heavy equipment traffic directly on wet silty soils should be avoided whenever possible. In our experience, these soils when subjected to heavy repetitive loads often become unstable and are subject to excessive rutting and pumping. These soils will provide poor subgrade support for pavements. Depending on the time of year and amount of precipitation, the exposed subgrade soils may not pass proofrolling. The project team should be prepared for subgrade repair measures if the soils are wet. Options such as chemical stabilization, removal and replacement, placement of surge stone, or placement of geotextiles are common for these soils. Recommendations for treated subgrades are provided in **Section 4.6.1**.

4.2 Earthwork

4.2.1 Site Preparation

At the onset of site grading to develop the proposed structure and associated pavement areas, all vegetation, topsoil, and any otherwise unsuitable material should be removed from the construction areas.

Prior to placement of fills to develop site grading, the exposed subgrade soils should be observed and proofrolled where practical prior to placement of engineered fill. Proof-rolling should be performed with a loaded, tandem-axle dump truck, or similar equipment with a gross weight of 15 tons. Soft, dry (desiccated) and low-density soil should be removed or compacted in place prior to placing fill. We recommend that the exposed subgrade be thoroughly evaluated prior to the start of fill operations.

The moisture content and density of the top 9 inches of the subgrade should be evaluated and the pavement subgrades proofrolled within 2 days prior to commencement of actual paving operations. Areas not in compliance with the required ranges of moisture or density should be moisture conditioned and recompacted. Particular attention should be paid to high traffic areas that were rutted and disturbed earlier and to areas where backfilled trenches are located. Areas where unsuitable conditions are located should be repaired by removing and replacing the materials with properly compacted fills.

Proofrolling should be accomplished in the presence of a Terracon representative. Proofrolling is helpful in identifying the presence of soft or unsuitable soils at shallow depths. Soft unsuitable soils that cannot be satisfactorily improved by scarification and re-compaction should be removed and replaced.

4.2.2 Material Requirements

Fill materials should consist of approved materials that are free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the geotechnical engineer for evaluation. Compacted engineered fill should meet the following material property requirements:

Fill Type	USCS Classification	Acceptable Location for Placement
Lean Clay	CL (LL<50)	All locations and elevations; except as LVC material unless material explicitly meets below requirements.
Fat Clay	CH (LL>50)	> 24 inches below building finished grade
Well-graded Granular	GM ¹	All locations and elevations
Low Volume Change (LVC) Material ²	CL (LL<45 & PI<22) GM ¹ Treated clay ³	All locations and elevations
On-site Soils	ML, CL, CH	The on-site soils generally appeared suitable for re-use in the pavement areas and at depths greater than 24 inches below building finished grade.

1. Similar to MoDOT Type 5 crushed limestone aggregate or crushed stone containing at least 18% low plasticity fines may also be used. Material should be approved by the geotechnical engineer.
2. Low plasticity cohesive soil or granular soil having low plasticity fines. Material should be approved by the geotechnical engineer.
3. On-site clays should be treated with at least 5% lime or 15% class C fly-ash.

4.2.3 Compaction Requirements

Item	Applicable Depth	Description
Fill Lift Thickness ¹	All depths	8 inches or less in loose thickness

Item		Applicable Depth	Description
Compaction Requirements ²		All depths	95% of the materials maximum standard Proctor dry density (ASTM D 698)
Moisture Content Clay Soil	LL<45	All depths	-2% to +2% of optimum moisture content value ³
	LL>45		0 to 4% above the optimum moisture content value ^{3,4}
Moisture Content Treated Soil		Pavement areas	0 to 4% above the optimum moisture content value ³
		LVC	
Moisture Content Granular Material		All depths	Workable moisture levels ⁴

1. Reduced lift thicknesses are recommended in confined areas (e.g., utility trenches, foundation excavations, and foundation backfill) and when hand-operated compaction equipment is used.
2. We recommend that engineered fill be tested for moisture content and compaction during placement. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.
3. As determined by the standard Proctor test. Treated Proctor will be required for treated soils.
4. Specifically, moisture levels should be maintained low enough to allow for satisfactory compaction to be achieved without the cohesionless fill material pumping when proofrolled.

4.2.4 Utility Trench Backfill

All trench excavations should be made with sufficient working space to permit construction including backfill placement and compaction. If utility trenches are backfilled with relatively clean granular material, they should be capped with at least 18 inches of cohesive fill to reduce the infiltration and conveyance of surface water through the trench backfill.

Utility trenches are common sources of water infiltration and migration. All utility trenches that penetrate beneath the building should be effectively sealed to restrict water intrusion and flow through the trenches that could migrate below the building. We recommend constructing an effective “trench plug” that extends at least 5 feet out from the face of the building exterior. The plug material should consist of clay compacted at a water contact at or above the soil’s optimum water content. The clay fill should be placed to completely surround the utility line and be compacted in accordance with recommendations in this report.

4.2.5 Grading and Drainage

Final surrounding grades should be sloped away from the structures on all sides to prevent ponding of water next to the buildings. Trees or other vegetation whose root systems have the ability to remove excessive moisture from the subgrade and foundation soils should not be planted next to the structure. Trees and shrubbery should be kept away from the exterior edges of the foundation element a distance at least equal to 1.5 times their expected mature height.

4.2.6 Earthwork Construction Considerations

Although the exposed subgrade is anticipated to be relatively stable upon initial exposure, unstable subgrade conditions could develop during general construction operations, particularly if the soils are wetted and/or subjected to repetitive construction traffic. Should unstable subgrade conditions develop stabilization measures will need to be employed.

Upon completion of filling and grading, care should be taken to maintain the subgrade moisture content prior to construction of the floor slabs and pavements. Construction traffic over the completed subgrade should be avoided to the extent practical. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. If the subgrade should become frozen, desiccated, saturated, or disturbed, the affected material should be removed or these materials should be scarified, moisture conditioned, and recompacted prior to construction of the floor slabs and pavements.

The geotechnical engineer should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observations during subgrade preparation, proof-rolling, placement and compaction of controlled compacted fills, backfilling of excavations, and just prior to construction of the building floor slabs and pavements.

4.3 Foundations

In our opinion, the proposed buildings can be supported on shallow foundations bearing on or within native stiff fat clay, lean clay, or silt; or properly compacted engineered fill. Additional opinions concerning design of foundations at this site are presented in the following paragraphs.

4.3.1 Foundation Design Recommendations

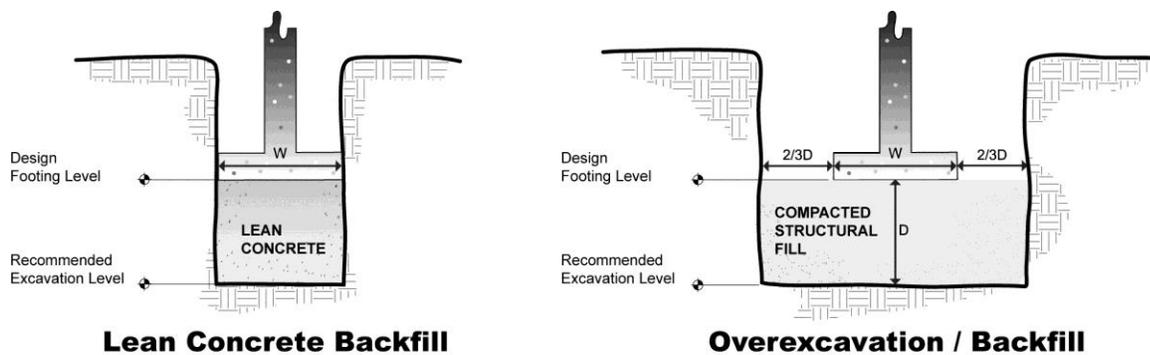
Description	Column	Wall
Net Allowable Bearing Pressure¹		
■ Native Soils or Compacted Engineered Fill	2,000 psf	2,000 psf
Minimum Width	30 inches	18 inches
Minimum Embedment Below Finished Grade²	36 inches	36 inches
Approximate Total Settlement From Foundation Loads³	1 inch	1 inch
Estimated Differential Settlement From Foundation Loads³	<3/4 inch between columns	< 3/4 inch over 40 feet
Allowable Passive Pressure⁴	750 psf	
Allowable Coefficient of Sliding Friction⁴	0.3	

1. The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation and considers a factor of safety of 3.
2. The embedment depth is for frost protection and to reduce the effects of seasonal moisture

Description	Column	Wall
<p>variations in the subgrade soils for perimeter footings and footings beneath unheated areas.</p> <p>3. Settlement of foundations supported on approved engineered fill or native soils.</p> <p>4. The shallow footing foundation excavation sides must be nearly vertical and the concrete should be placed neat against these vertical faces for the passive earth pressure values to be valid. If the loaded side is sloped or benched, and then backfilled, the allowable passive pressure will be significantly reduced. Passive resistance in the upper 3 feet of the soil profile should be neglected. If passive resistance is used to resist lateral loads, the base friction should be neglected.</p>		

4.3.2 Foundation Construction Considerations

If unsuitable bearing soils are encountered in footing excavations, the excavation could be extended deeper to suitable soils and the footing could bear directly on these soils at the lower level or on lean concrete backfill placed in the excavations. As an alternative, the footings could also bear on properly compacted engineered backfill extending down to the suitable soils. Overexcavation for compacted engineered fill placement below footings should extend laterally beyond all edges of the footings at least 8 inches per foot of overexcavation depth below footing base elevation. The overexcavation should then be backfilled up to the footing base elevation with well graded granular material placed in lifts of 8 inches or less in loose thickness (4 to 6 inches if using hand-guided compaction equipment) and compacted to at least 98 percent of the material's standard effort maximum dry density (ASTM D 698). The overexcavation and backfill procedure is described in the following figure.



NOTE: Excavations in sketches shown vertical for convenience. Excavations should be sloped as necessary for safety.

4.4 Floor Slabs

To develop uniform floor slab support for the proposed buildings, we recommend placing a low volume change (LVC) layer immediately below floor slabs. Recommendations for the proposed LVC layer are provided in the below table.

Item	Description
Floor slab support	A minimum 24-inch low volume change (LVC) zone should be developed below grade supported floors ^{1,2}

Item	Description
Modulus of subgrade reaction	100 pounds per square inch per inch (psi/in) for point loading conditions
Granular leveling course layer thickness ^{3,5}	4 inches
Capillary break layer thickness ^{4,5}	6 inches

1. Loads on footings which support structural walls and column loads will be greater than floor slab loads. Consequently, footings should be expected to settle more and at different rates than the adjacent floor slab. Differential movement between foundations and grade-supported floors should be considered by the structural engineer.
2. We recommend subgrades be maintained in a relatively moist condition until the floor slab is constructed. If the subgrade should become desiccated prior to construction of the floor slab, the affected material should be removed or the materials scarified, moistened, and recompact. Upon completion of grading operations in the building area, care should be taken to maintain the recommended subgrade moisture content and density prior to construction of the building floor slab.
3. If the purpose of this layer is solely to create a level base for concrete placement to maintain a more uniform slab thickness, well graded sand, gravel or crushed stone can be used.
4. If penetration of moisture vapor through the slab is a concern, in our opinion the floor slab design should include a capillary break layer instead of the granular leveling course layer described above. In our opinion, capillary break layers should be comprised of granular materials that have less than 5 percent fines (material passing the #200 sieve). Other design considerations such as cold temperatures and condensation development could warrant addition design considerations.
5. These granular materials may be considered part of the LVC zone.

4.5 Seismic Considerations

Code Reference	Site Classification
2009 International Building Code (IBC)	D ¹

1. The 2009 International Building Code (IBC) site profile determination is based on average properties of the subsurface profile to a depth of 100 feet. Borings extended to a maximum depth of approximately 40 feet. Our opinion of site classification is based on our knowledge of the local geology and geotechnical conditions.

4.6 Pavements

4.6.1 Subgrade Preparation

The lean clay, silt, and sandy soils present on portions of the site are moisture sensitive and will be soft if saturated. Depending on the time of year, it may be difficult to moisture condition these materials so that they can pass a proof roll. If clay subgrades do not pass initial proofrolling and/or cannot be properly moisture conditioned, the contractor may consider chemical treatment of the existing clay soils. Treatment of clay soils can be achieved by addition of 15% Class C fly ash on a dry weight basis. Class C fly ash reacts quickly with water and so, for these reasons,

Class C fly ash is normally applied in dry bulk form and mixed with the soil prior to adding water. This application procedure results in significant “dusting”. If dusting is a concern, subgrade stabilization can be accomplished using a lime slurry. The lime slurry mixture should be such that the amount of hydrated or quicklime lime is at least 5% based on the dry weight of soil being stabilized.

If proofrolling indicates that soft subgrade soils extend deeper in certain areas, other treatment options may be required, such as undercutting the poor soil and replacing with good soil, placing geotextile and gravel, or working surgestone (large pieces of rock generally 4 to 12 inches in size) into the subgrade soils. The conditions at the time of construction, the budget, availability of materials, and contractors experience will be considered to evaluate the options. As previously discussed, Terracon should be retained during construction to observe site preparation and proofrolling of pavement subgrades; and to assist the project team in determining suitable options to stabilize soft subgrades, where observed.

4.6.2 Pavement Design Considerations

Terracon performed one (1) California Bearing Ratio (CBR) tests based on 95% of the standard Proctor dry unit weight for a composite sample collected at Borings B-5, B-6, and B-7 from 1’ to 4’ below grade. These tests yielded a CBR values of 6.7 for soils compacted to 95% of the standard Proctor dry unit weight and near optimum moisture content.

Specific information on the type and volume of anticipated traffic was not provided by the Client. We anticipate parking lot traffic will consist primarily of personal vehicles (automobiles and pick-up trucks) and we have provided recommendations for pavement subjected to heavy truck traffic which will not exceed 10 trucks per week. Subgrade preparation will be important to the long-term performance of the pavements. The pavement sections provided below represent minimum recommended thicknesses and, as such, regular maintenance should be anticipated.

4.6.3 Asphaltic Cement Concrete (ACC) Thickness Design Recommendations

Minimum Recommended ACC Pavement Section Thickness (inches)			
Traffic Area	Asphalt Surface	Asphalt Base	Total Thickness
Light Duty (Automobile Parking)	2.0	4.0	6.0
Heavy Duty (Drive Lanes/ Entrances/Exits)	2.0	6.0	8.0

4.6.4 Asphaltic Cement Concrete (ACC) Thickness Design Recommendations

Minimum Recommended PCC Pavement Section Thickness (inches)			
Traffic Area	Portland Cement Concrete	Aggregate Base ¹	Total Thickness
Light Duty	5.0	4.0	9.0

Minimum Recommended PCC Pavement Section Thickness (inches)			
Traffic Area	Portland Cement Concrete	Aggregate Base¹	Total Thickness
(Automobile Parking)			
Heavy Duty (Drive Lanes/ Entrances/Exits)	6.0	4.0	10.0
Dumpster Pad²	7.0	4.0	11.0

1. Aggregate base material consisting of open graded rock (ASTM C 33 Size No. 57 Aggregate or similar).
2. The dumpster pad, if planned, should be large enough to support the container and the tipping axle of the collection truck.

We recommend Portland cement concrete (PCC) pavements in any areas subjected to heavy wheel loads and/or turning traffic, such as traffic and movement from delivery trucks.

4.6.5 Pavement Drainage

Pavements should be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the pavements could saturate the subgrade and contribute to premature pavement deterioration. In addition, the pavement subgrade should be graded to provide positive drainage within the granular base section. Appropriate sub-drainage or connection to a suitable daylight outlet should be provided to remove water from the granular subbase.

4.6.6 Pavement Maintenance

The pavement sections provided in this report represent minimum recommended thicknesses and, as such, periodic maintenance should be anticipated. Therefore, preventive maintenance should be planned and provided for through an on-going pavement management program.

5.0 GENERAL COMMENTS

Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we

Geotechnical Engineering Report

139th Security Building ■ St. Joseph, MO
November 21, 2013 ■ Terracon Project No. 02135197

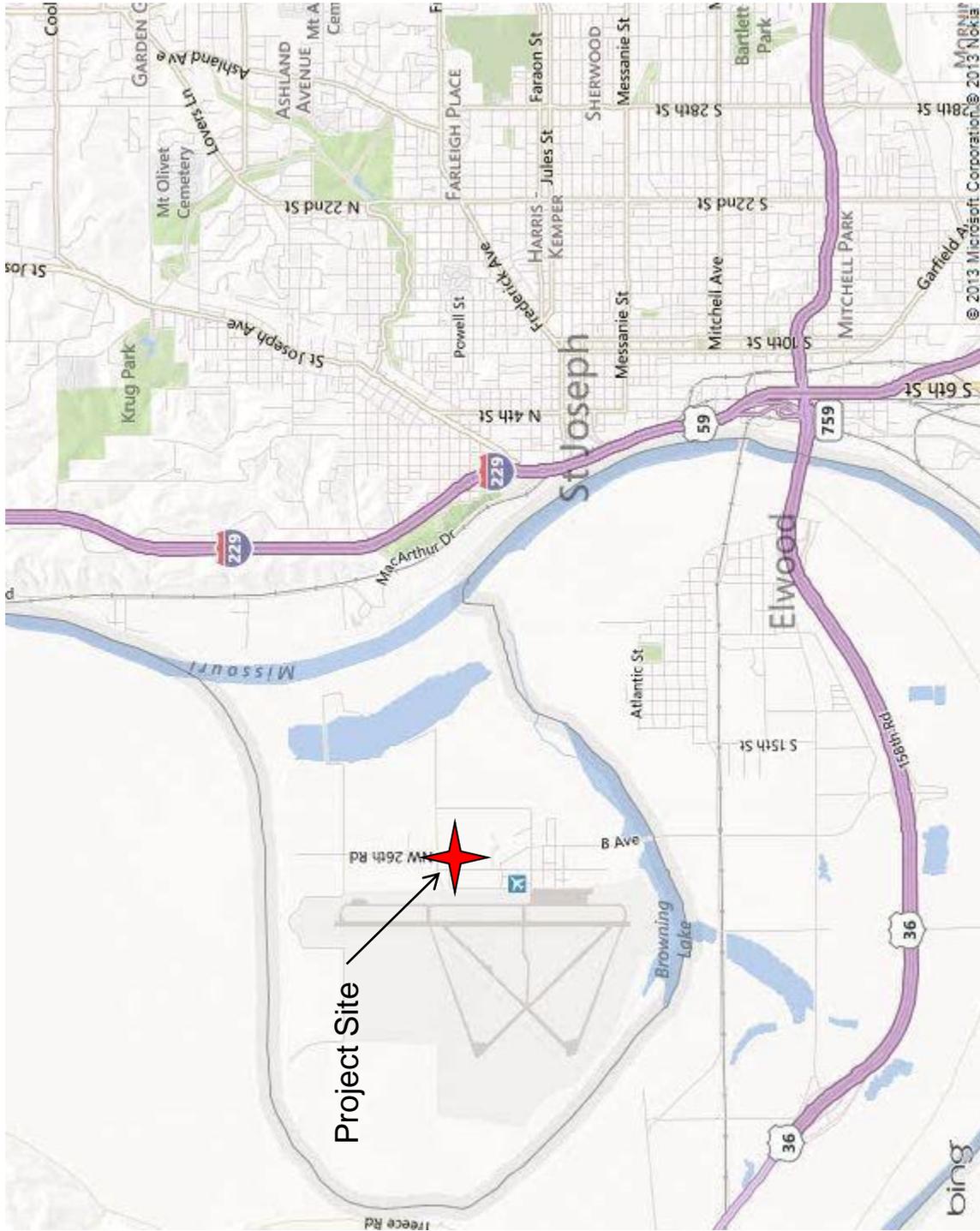


should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A
FIELD EXPLORATION



Project Site



Exhibit
A-1

SITE LOCATION PLAN
139th Security Forces Building
Panigot Road and 26th Road
ST. JOSEPH, MO

Terracon
Consulting Engineers & Scientists
13910 West 96th Terrace
Lenexa, Kansas 66215
PH: (913) 492-7777 FAX: (913) 492-7443

Project No.	02135197
Scale:	N.T.S.
File Name:	1130a.dwg
Date:	11/12/2013

Project Manager:	BWL
Drawn by:	BWL
Checked by:	BWL
Approved by:	BWL

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

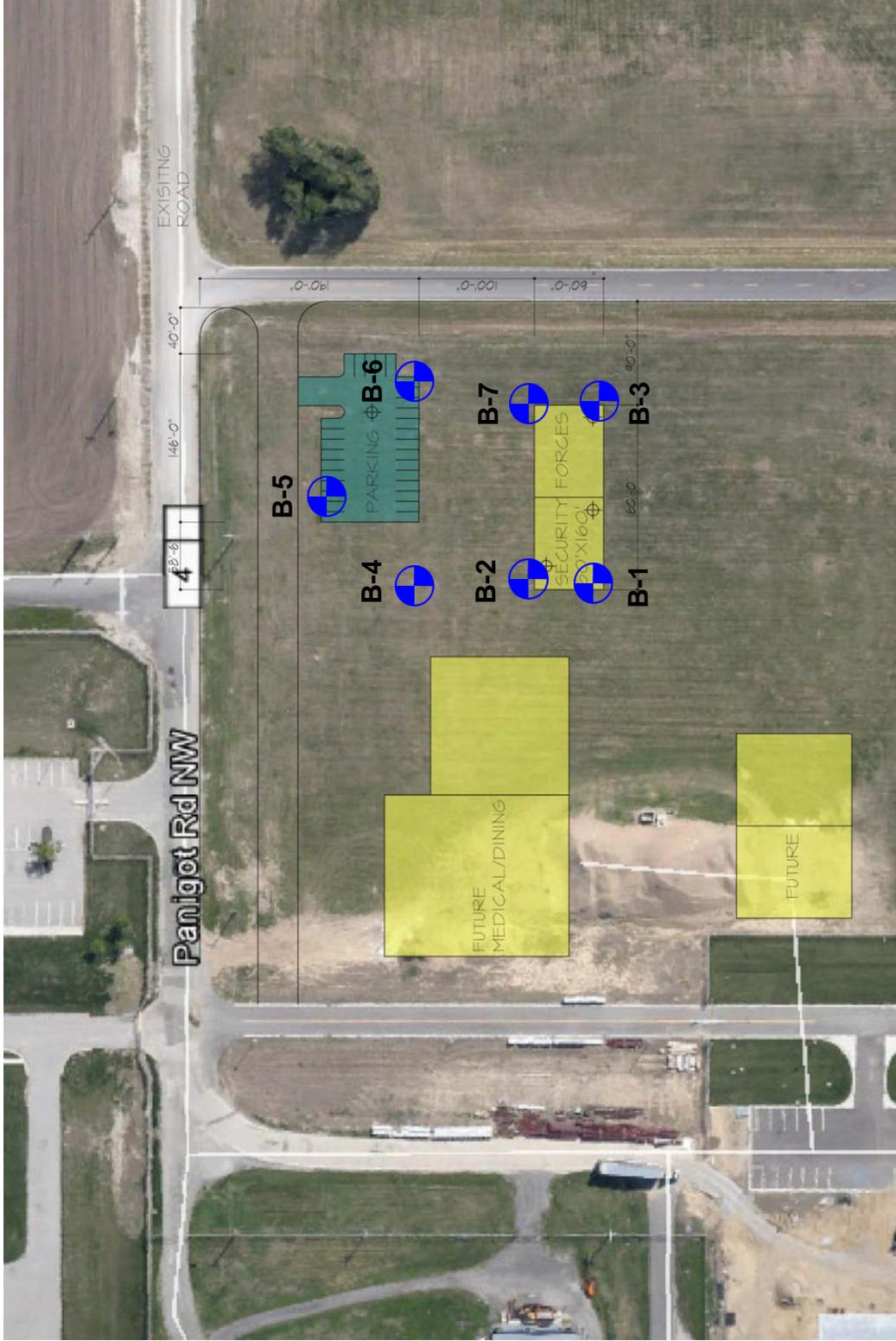


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Exhibit
A-2

BORING LOCATION PLAN
139th Security Forces Building
Panigot Road and 26th Road
ST. JOSEPH, MO

Terracon
Consulting Engineers & Scientists
13910 West 96th Terrace
Lenexa, Kansas 66215
PH. (913) 492-7777 FAX. (913) 492-7443

Project No. 02135197
Scale: N.T.S.
File Name: 116a.dwg
Boring Location: 116a.dwg
Date: 11/12/2013

Project Manager: BWL
Drawn by: BWL
Checked by: BWL
Approved by: BWL

BORING LOG NO. B-1

PROJECT: 139th Security Forces Building

**CLIENT: HTK Architects
Topeka, KS**

**SITE: Panigot Road and 26th Road
St. Joseph, MO**

GRAPHIC LOG	LOCATION See Exhibit A-2	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)
	Approximate Surface Elev. 817 (Ft.) +/-								
	DEPTH	ELEVATION (Ft.)							
	0.3' ^ 4" TOPSOIL	817+/-							
	FAT CLAY (CH) , gray-brown, hard	5				+9000 (HP)		13	108
		8.0				+9000 (HP)		8	
		8.0				+9000 (HP)		14	
	SILT (ML) , sandy, brown to gray, medium stiff to stiff	809+/-						24	
		15	▽		2-2-2 N=4			40	
		20			2-3-3 N=6			27	
		25			6-7-8 N=15			29	
		28.5			6-19-20 N=39			19	
	SAND (SP) , gray, medium dense to dense	788.5+/-			10-10-15 N=25			21	
		35			10-15-20 N=35			20	
		40.0							
	Boring Terminated at 40 Feet								
	777+/-								

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
0-20': Hollow-stem auger
20'-40': Wash boring

See Exhibit A-10 for description of field procedures
See Appendix B for description of laboratory procedures and additional data (if any).

Notes:

Abandonment Method:
Boring backfilled with soil cuttings and bentonite chips upon completion.

See Appendix C for explanation of symbols and abbreviations.

WATER LEVEL OBSERVATIONS
▽ While sampling

13910 West 96th Terrace
Lenexa, Kansas

Boring Started: 10/21/2013	Boring Completed: 10/22/2013
Drill Rig: CME 550	Driller: SS
Project No.: 02135197	Exhibit: A-3

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BORING LOG NO. B-2

PROJECT: 139th Security Forces Building

**CLIENT: HTK Architects
Topeka, KS**

**SITE: Panigot Road and 26th Road
St. Joseph, MO**

GRAPHIC LOG	LOCATION See Exhibit A-2	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)
	Approximate Surface Elev. 817.5 (Ft.) +/-								
	0.3' 4" TOPSOIL	817.5+/-							
	FAT CLAY (CH) , brown, very stiff to hard					8500 (HP)		17	
		5					6148	20	99
	6.0' LEAN CLAY (CL) , silty, brown, medium stiff	811.5+/-					3591	27	91
		10		X	2-2-2 N=4			39	
		15	▽	X	2-2-3 N=5			29	
	13.5' SILT (ML) , sandy, gray-brown, loose	804+/-		X	2-3-4 N=7			14	
	20.0'	797.5+/-		X					
	Boring Terminated at 20 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

<p>Advancement Method:</p> <p>Abandonment Method: Boring backfilled with soil cuttings and bentonite chips upon completion.</p>	<p>See Exhibit A-10 for description of field procedures</p> <p>See Appendix B for description of laboratory procedures and additional data (if any).</p> <p>See Appendix C for explanation of symbols and abbreviations.</p>	<p>Notes:</p>
<p>WATER LEVEL OBSERVATIONS</p> <p>▽ While drilling</p>	<p>13910 West 96th Terrace Lenexa, Kansas</p>	
	<p>Boring Started: 10/22/2013</p> <p>Drill Rig: CME 550</p> <p>Project No.: 02135197</p>	<p>Boring Completed: 10/22/2013</p> <p>Driller: SS</p> <p>Exhibit: A-4</p>

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BORING LOG NO. B-3

PROJECT: 139th Security Forces Building

**CLIENT: HTK Architects
Topeka, KS**

**SITE: Panigot Road and 26th Road
St. Joseph, MO**

GRAPHIC LOG	LOCATION See Exhibit A-2	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)
	Approximate Surface Elev. 816.5 (Ft.) +/-								
	0.3' ^ 4" TOPSOIL	816.5+/-							
	FAT CLAY (CH) , silty, brown, medium stiff to stiff			X	6-5-4 N=9			11	
		5		X	2-3-3 N=6			21	
		8.0		X	5-5-4 N=9			28	
	LEAN CLAY (CL) , silty, brown, medium stiff	808.5+/-		X	2-2-2 N=4			33	
		10	▽						
		15		X	2-2-2 N=4			33	
		18.5							
	SILT (ML) , sandy, gray, loose	798+/-		X	1-2-3 N=5			36	
		20.0							
	Boring Terminated at 20 Feet	796.5+/-							

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method: Abandonment Method: Boring backfilled with soil cuttings and bentonite chips upon completion.	See Exhibit A-10 for description of field procedures See Appendix B for description of laboratory procedures and additional data (if any). See Appendix C for explanation of symbols and abbreviations.	Notes:
WATER LEVEL OBSERVATIONS ▽ While drilling	13910 West 96th Terrace Lenexa, Kansas	
	Boring Started: 10/22/2013 Drill Rig: CME 550 Project No.: 02135197	Boring Completed: 10/22/2013 Driller: SS Exhibit: A-5

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BORING LOG NO. B-4

PROJECT: 139th Security Forces Building

**CLIENT: HTK Architects
Topeka, KS**

**SITE: Panigot Road and 26th Road
St. Joseph, MO**

GRAPHIC LOG	LOCATION See Exhibit A-2	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)
	Approximate Surface Elev. 817.5 (Ft.) +/-								
	DEPTH 0.3' 4" TOPSOIL ELEVATION (Ft.) 817+/-								
	SILT (ML) , brown, medium stiff to stiff	5			3-4-4 N=8			10	
					3-2-3 N=5			11	
					6-6-3 N=9			15	
	DEPTH 8.5' SAND (SP) , brown to gray-brown, loose to medium dense ELEVATION (Ft.) 809+/-	10			4-5-6 N=11			5	
					4-5-5 N=10			12	
					2-3-4 N=7			17	
	DEPTH 20.0' Boring Terminated at 20 Feet ELEVATION (Ft.) 797.5+/-	20							

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method: Abandonment Method: Boring backfilled with soil cuttings and bentonite chips upon completion.	See Exhibit A-10 for description of field procedures See Appendix B for description of laboratory procedures and additional data (if any). See Appendix C for explanation of symbols and abbreviations.	Notes:
WATER LEVEL OBSERVATIONS ▽ While drilling	<p style="font-size: small;">13910 West 96th Terrace Lenexa, Kansas</p>	Boring Started: 10/22/2013 Boring Completed: 10/22/2013 Drill Rig: CME 550 Driller: SS Project No.: 02135197 Exhibit: A-6

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BORING LOG NO. B-5

PROJECT: 139th Security Forces Building

**CLIENT: HTK Architects
Topeka, KS**

**SITE: Panigot Road and 26th Road
St. Joseph, MO**

GRAPHIC LOG	LOCATION See Exhibit A-2	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)
	Approximate Surface Elev. 819.0 (Ft.) +/-								
	ELEVATION (Ft.)								
0.5	6" TOPSOIL	818.5+/-							
1.5	LEAN CLAY (CL) , dark brown	817.5+/-			4-4-3 N=7			9	
	SILT (ML) , sandy, brown, medium stiff				3-3-2 N=5			11	
8.5		810.5+/-			3-4-4 N=8			13	
10.0	SAND (SP) , with silt, brown, stiff	809+/-			4-5-6 N=11			10	
	Boring Terminated at 10 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

<p>Advancement Method:</p> <p>Abandonment Method: Boring backfilled with soil cuttings and bentonite chips upon completion.</p>	<p>See Exhibit A-10 for description of field procedures</p> <p>See Appendix B for description of laboratory procedures and additional data (if any).</p> <p>See Appendix C for explanation of symbols and abbreviations.</p>	<p>Notes:</p> 						
<p>WATER LEVEL OBSERVATIONS</p> <p><i>No free water observed</i></p>	<p>13910 West 96th Terrace Lenexa, Kansas</p>	<table style="width: 100%; border: none;"> <tr> <td style="border: none;">Boring Started: 10/22/2013</td> <td style="border: none;">Boring Completed: 10/22/2013</td> </tr> <tr> <td style="border: none;">Drill Rig: CME 550</td> <td style="border: none;">Driller: SS</td> </tr> <tr> <td style="border: none;">Project No.: 02135197</td> <td style="border: none;">Exhibit: A-7</td> </tr> </table>	Boring Started: 10/22/2013	Boring Completed: 10/22/2013	Drill Rig: CME 550	Driller: SS	Project No.: 02135197	Exhibit: A-7
Boring Started: 10/22/2013	Boring Completed: 10/22/2013							
Drill Rig: CME 550	Driller: SS							
Project No.: 02135197	Exhibit: A-7							

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BORING LOG NO. B-6

PROJECT: 139th Security Forces Building

**CLIENT: HTK Architects
Topeka, KS**

**SITE: Panigot Road and 26th Road
St. Joseph, MO**

GRAPHIC LOG	LOCATION See Exhibit A-2	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)
	Approximate Surface Elev. 817.5 (Ft.) +/-								
	DEPTH	ELEVATION (Ft.)							
	0.3' 4" TOPSOIL	817.5+/-							
	3.0' FAT CLAY (CH) , brown, medium stiff	814.5+/-		X	3-3-3 N=6			30	
	SILT (ML) , sandy, brown, medium stiff			X	3-3-2 N=5			16	
				X	3-3-2 N=5			16	
				X	3-3-3 N=5			16	
	10.0' Boring Terminated at 10 Feet	807.5+/-							

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method: Abandonment Method: Boring backfilled with soil cuttings and bentonite chips upon completion.	See Exhibit A-10 for description of field procedures See Appendix B for description of laboratory procedures and additional data (if any). See Appendix C for explanation of symbols and abbreviations.	Notes:
WATER LEVEL OBSERVATIONS <i>No free water observed</i>		
	Boring Started: 10/22/2013 Drill Rig: CME 550 Project No.: 02135197	Boring Completed: 10/22/2013 Driller: SS Exhibit: A-8

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BORING LOG NO. B-7

PROJECT: 139th Security Forces Building

**CLIENT: HTK Architects
Topeka, KS**

**SITE: Panigot Road and 26th Road
St. Joseph, MO**

GRAPHIC LOG	LOCATION See Exhibit A-2	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)
	Approximate Surface Elev. 816.5 (Ft.) +/-								
	0.5' 6" TOPSOIL								
	FAT CLAY (CH) , silty, brown, medium stiff to stiff	5		X	3-4-5 N=9			21	
		5		X	3-4-4 N=8			25	
		8.5		X	2-2-2 N=4			27	
	10.0' SILT (ML) , sandy, brown, medium stiff	10		X	2-3-4 N=7			26	
	Boring Terminated at 10 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

<p>Advancement Method:</p> <p>Abandonment Method: Boring backfilled with soil cuttings and bentonite chips upon completion.</p>	<p>See Exhibit A-10 for description of field procedures</p> <p>See Appendix B for description of laboratory procedures and additional data (if any).</p> <p>See Appendix C for explanation of symbols and abbreviations.</p>	<p>Notes:</p>						
<p>WATER LEVEL OBSERVATIONS</p> <p><i>No free water observed</i></p>	<p>13910 West 96th Terrace Lenexa, Kansas</p>	<table style="width: 100%; border: none;"> <tr> <td style="border: none;">Boring Started: 10/22/2013</td> <td style="border: none;">Boring Completed: 10/22/2013</td> </tr> <tr> <td style="border: none;">Drill Rig: CME 550</td> <td style="border: none;">Driller: SS</td> </tr> <tr> <td style="border: none;">Project No.: 02135197</td> <td style="border: none;">Exhibit: A-9</td> </tr> </table>	Boring Started: 10/22/2013	Boring Completed: 10/22/2013	Drill Rig: CME 550	Driller: SS	Project No.: 02135197	Exhibit: A-9
Boring Started: 10/22/2013	Boring Completed: 10/22/2013							
Drill Rig: CME 550	Driller: SS							
Project No.: 02135197	Exhibit: A-9							

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL_02135197.GPJ TERRACON_STD_TEMPLATE.GDT 11/2/13

Field Exploration Description

The proposed boring locations were staked in the field by a Terracon representative measuring distance from available site features. Boring elevations were provided the project surveyors. The borings were drilled with an ATV-mounted rotary drill rig using flight augers to advance the boreholes. Samples of the soil encountered in the borings were obtained using the thin-walled tube and split-barrel sampling procedures.

In the thin-walled tube sampling procedure, a 2-inch diameter, thin-walled, seamless steel tube with a sharp cutting edge is pushed hydraulically into the soil to obtain a relatively undisturbed sample. In the split-barrel sampling procedure, a standard 2-inch O.D. split-barrel sampling spoon is driven into the ground by a 140 pound hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18 inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths.

The samples were tagged for identification, sealed to reduce moisture loss, and taken to our laboratory for further examination, testing, and classification. Information provided on the boring logs attached to this report includes soil descriptions, consistency evaluations, boring depths, sampling intervals, and groundwater conditions. The borings were backfilled with auger cuttings prior to the drill crew leaving the site.

A field log of each boring was prepared by the drill crew. These logs included visual classifications of the materials encountered during drilling as well as the driller's interpretation of the subsurface conditions between samples. Final boring logs included with this report represent the engineer's interpretation of the field logs and include modifications based on laboratory observation and tests of the samples.

APPENDIX B
SUPPORTING INFORMATION

Geotechnical Engineering Report

139th Security Building ■ St. Joseph, MO
November 21, 2013 ■ Terracon Project No. 02135197



Laboratory Testing

Representative soil samples were tested in the laboratory to measure their natural water content, dry unit weight, unconfined compressive strength, and Atterberg limits. A calibrated hand penetrometer was also used to estimate the approximate unconfined compressive strength of some samples. The calibrated hand penetrometer has been correlated with unconfined compression tests. The test results are provided on the boring logs included in Appendix A.

One (1) standard Proctor and one (1) California Bearing Ratio (CBR) tests were performed on a bulk sample collected at borings B-5, B-6, and B-7 from 1 to 4 feet below grade. These test results are provided in Appendix B.

Descriptive classifications of the soils indicated on the boring logs are in accordance with the enclosed General Notes and the Unified Soil Classification System. Also shown are estimated Unified Soil Classification Symbols. A brief description of this classification system is attached to this report. All classification was by visual manual procedures.

LABORATORY COMPACTION CHARACTERISTICS OF SOIL REPORT



Report Number: 02135197.0001

Service Date: 10/28/13

Report Date: 10/30/13

13910 W. 96th Ter.

Lenexa, KS 66215

913-492-7777

Client

HTK Architects
Attn: Keith Blackburn
2900 Southwest McVicar Avenue
Topeka, KS 66611

Project

139th Security Forces Building
139th Security Forces Buildings
St. Joseph, MO

Project Number 02135197

Material Information

Source of Material:

Proposed Use:

Sample Information

Sample Date: 10/28/13

Sampled By:

Sample Location: Combined Borings B-5, B-6, B-7, Bulk
Sample, 1.0 - 4.0 feet

Sample Description: Lean Clay (CL), brown

Laboratory Test Data

Test Procedure: ASTM D698

Test Method: Method A

Sample Preparation: Dry

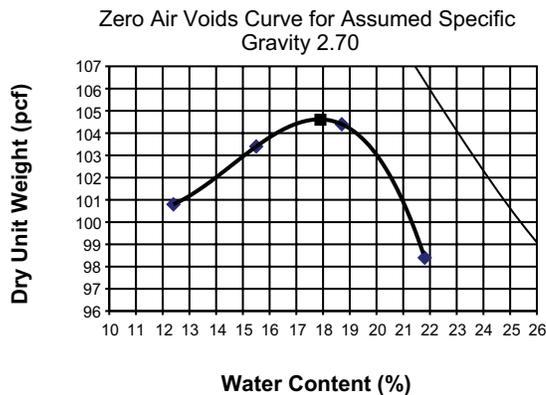
Rammer Type: Mechanical

Maximum Dry Unit Weight (pcf): 104.6

Optimum Water Content (%): 17.9

	Result	Specifications
Liquid Limit:	49	
Plastic Limit:	18	
Plasticity Index:	31	
In-Place Moisture (%):		

USCS:



Comments:

Test Methods: ASTM D698

The tests were performed in general accordance with applicable ASTM, AASHTO, or DOT test methods. This report is exclusively for the use of the client indicated above and shall not be reproduced except in full without the written consent of our company. Test results transmitted herein are only applicable to the actual samples tested at the location(s) referenced and are not necessarily indicative of the properties of other apparently similar or identical materials.

California Bearing Ratio of Laboratory-Compacted Soils



Report Number: 02135197.0001
Service Date: 10/28/13
Report Date: 10/30/13
Task:

13910 W. 96th Ter.
Lenexa, KS 66215
913-492-7777

Client

HTK Architects
Attn: Keith Blackburn
2900 Southwest McVicar Avenue
Topeka, KS 66611

Project

139th Security Forces Building
139th Security Forces Buildings
St. Joseph, MO

Project No. 02135197

SAMPLE INFORMATION

Sample Number: _____
Boring Number: COMBINED BORINGS B-5, B-6, & B-7
Sample Location: BULK SAMPLE
Depth: 1.0-4.0 FEET
Material Description: LEAN CLAY, BROWN

Proctor Method: ASTM D698 - Method A
Maximum Dry Density (pcf): 104.6
Optimum Moisture: 17.9
Liquid Limit: 49
Plasticity Index: 31

CBR TEST DATA

CBR Value at 0.100 inch 7.0
CBR Value at 0.200 inch 6.7

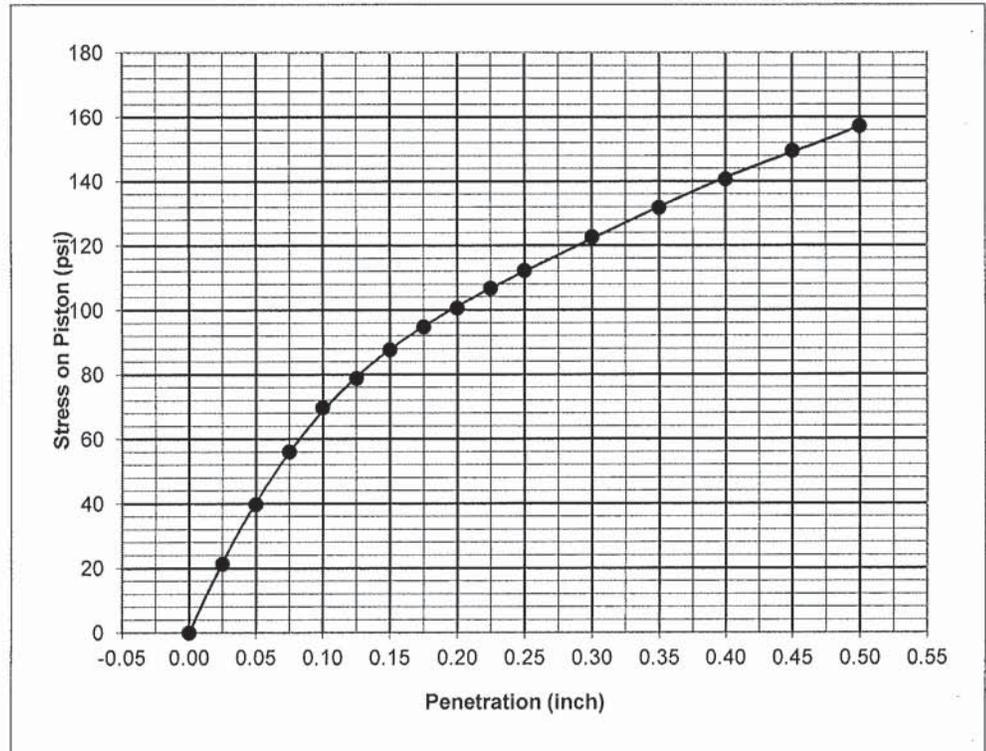
Surcharge Weight (lbs) 10
Soaking Condition Soaked
Length of Soaking (hours) 96
Swell (%) 0.9

DENSITY DATA

Dry Density Before Soaking (pcf) 99.4
Compaction of Proctor (%) 95.1

MOISTURE DATA

Before Compaction (%) 18.2
After Compaction (%) 18.4
Top 1" After Soaking (%) 26.2
Average After Soaking (%) 23.4



The tests were performed in general accordance with applicable ASTM, AASHTO, or DOT test methods. This report is exclusively for the use of the client indicated above and shall not be reproduced except in full without the written consent of our company. Test results transmitted herein are only applicable to the actual samples tested at the location(s) referenced and are not necessarily indicative of the properties of other apparently similar or identical materials.

APPENDIX C
SUPPORTING DOCUMENTS

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING			WATER LEVEL		Water Initially Encountered	FIELD TESTS	(HP) Hand Penetrometer	
	Auger	Split Spoon			Water Level After a Specified Period of Time		(T) Torvane	
					Water Level After a Specified Period of Time		(b/f) Standard Penetration Test (blows per foot)	
	Shelby Tube	Macro Core		Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.			(PID) Photo-Ionization Detector	
							(OVA) Organic Vapor Analyzer	
Ring Sampler	Rock Core							
								
Grab Sample	No Recovery							

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS	RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance Includes gravels, sands and silts.			CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
	Descriptive Term (Density)	Standard Penetration or N-Value Blows/Ft.	Ring Sampler Blows/Ft.	Descriptive Term (Consistency)	Unconfined Compressive Strength, Qu, psf	Standard Penetration or N-Value Blows/Ft.
Very Loose	0 - 3	0 - 6	Very Soft	less than 500	0 - 1	< 3
Loose	4 - 9	7 - 18	Soft	500 to 1,000	2 - 4	3 - 4
Medium Dense	10 - 29	19 - 58	Medium-Stiff	1,000 to 2,000	4 - 8	5 - 9
Dense	30 - 50	59 - 98	Stiff	2,000 to 4,000	8 - 15	10 - 18
Very Dense	> 50	≥ 99	Very Stiff	4,000 to 8,000	15 - 30	19 - 42
			Hard	> 8,000	> 30	> 42

RELATIVE PROPORTIONS OF SAND AND GRAVEL

<u>Descriptive Term(s) of other constituents</u>	<u>Percent of Dry Weight</u>
Trace	< 15
With	15 - 29
Modifier	> 30

RELATIVE PROPORTIONS OF FINES

<u>Descriptive Term(s) of other constituents</u>	<u>Percent of Dry Weight</u>
Trace	< 5
With	5 - 12
Modifier	> 12

GRAIN SIZE TERMINOLOGY

<u>Major Component of Sample</u>	<u>Particle Size</u>
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 sieve (0.075mm)

PLASTICITY DESCRIPTION

<u>Term</u>	<u>Plasticity Index</u>
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests ^A				Soil Classification		
				Group Symbol	Group Name ^B	
Coarse Grained Soils: More than 50% retained on No. 200 sieve	Gravels: More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels: Less than 5% fines ^C	$Cu \geq 4$ and $1 \leq Cc \leq 3$ ^E	GW	Well-graded gravel ^F	
		Gravels with Fines: More than 12% fines ^C	Fines classify as ML or MH	GP	Poorly graded gravel ^F	
			Fines classify as CL or CH	GM	Silty gravel ^{F,G,H}	
		Sands: 50% or more of coarse fraction passes No. 4 sieve	Clean Sands: Less than 5% fines ^D	$Cu < 4$ and/or $1 > Cc > 3$ ^E	GC	Clayey gravel ^{F,G,H}
	Sands with Fines: More than 12% fines ^D		$Cu \geq 6$ and $1 \leq Cc \leq 3$ ^E	SW	Well-graded sand ^I	
			$Cu < 6$ and/or $1 > Cc > 3$ ^E	SP	Poorly graded sand ^I	
			Fines classify as ML or MH	SM	Silty sand ^{G,H,I}	
		Fines classify as CL or CH	SC	Clayey sand ^{G,H,I}		
Fine-Grained Soils: 50% or more passes the No. 200 sieve	Silts and Clays: Liquid limit less than 50	Inorganic:	$PI > 7$ and plots on or above "A" line ^J	CL	Lean clay ^{K,L,M}	
			$PI < 4$ or plots below "A" line ^J	ML	Silt ^{K,L,M}	
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay ^{K,L,M,N}
			Liquid limit - not dried		OH	Organic silt ^{K,L,M,O}
	Silts and Clays: Liquid limit 50 or more	Inorganic:	PI plots on or above "A" line	CH	Fat clay ^{K,L,M}	
			PI plots below "A" line	MH	Elastic Silt ^{K,L,M}	
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay ^{K,L,M,P}
			Liquid limit - not dried		OH	Organic silt ^{K,L,M,Q}
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat	

^A Based on the material passing the 3-inch (75-mm) sieve

^B If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

^C Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

^D Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

$$^E Cu = D_{60}/D_{10} \quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

^F If soil contains $\geq 15\%$ sand, add "with sand" to group name.

^G If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

^H If fines are organic, add "with organic fines" to group name.

^I If soil contains $\geq 15\%$ gravel, add "with gravel" to group name.

^J If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

^K If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

^L If soil contains $\geq 30\%$ plus No. 200 predominantly sand, add "sandy" to group name.

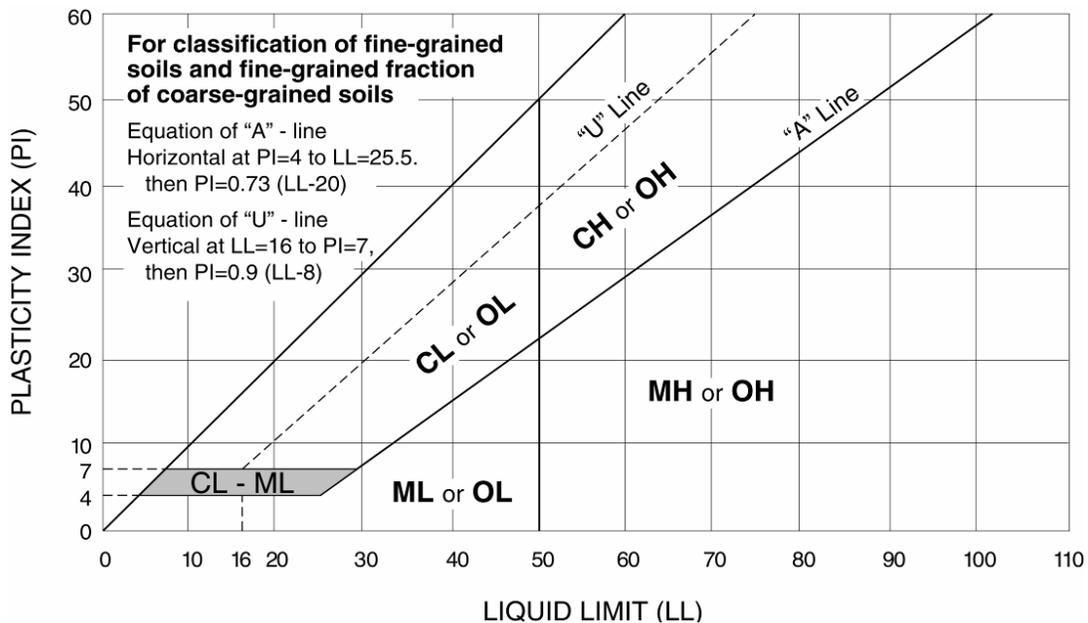
^M If soil contains $\geq 30\%$ plus No. 200, predominantly gravel, add "gravelly" to group name.

^N $PI \geq 4$ and plots on or above "A" line.

^O $PI < 4$ or plots below "A" line.

^P PI plots on or above "A" line.

^Q PI plots below "A" line.



SECTION 31 2319 - DEWATERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes construction dewatering.
- B. Related Sections:
 - 1. Division 31 Section "Earth Moving" for excavating, backfilling, site grading, and for site utilities.
 - 2. Division 31 Section "Excavation Support and Protection" for shoring, bracing, and sheet piling of excavations.

1.3 PERFORMANCE REQUIREMENTS

- A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.
 - 1. Delegated Design: Design dewatering system, including comprehensive engineering analysis by a qualified professional engineer in the State of Missouri, using performance requirements and design criteria indicated.
 - 2. Continuously monitor and maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, that excavation does not flood, and that damage to subgrades and permanent structures is prevented.
 - 3. Prevent surface water from entering excavations by grading, dikes, or other means.
 - 4. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
 - 5. Remove dewatering system when no longer required for construction.

1.4 SUBMITTALS

- A. Shop Drawings: For dewatering system. Show arrangement, locations, and details of wells and well points; locations of risers, headers, filters, pumps, power units, and discharge lines; and means of discharge, control of sediment, and disposal of water.
 - 1. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.
 - 2. Include a written plan for dewatering operations including control procedures to be adopted if dewatering problems arise, particularly the pumping/discharging of the contaminated effluent.

- B. Delegated-Design Submittal: For dewatering system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer in the State of Missouri responsible for their preparation.
- C. Qualification Data: For qualified Installer and professional engineer.
- D. Field quality-control reports.
- E. Other Informational Submittals:
 - 1. Photographs: Show existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by dewatering operations.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer that has specialized in dewatering work.
- B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning dewatering. Comply with hauling and disposal regulations of authorities having jurisdiction. Coordinate with the City of St. Joseph for discharge point into sewer system or provide hauling plan to an approved disposal location.
 - 1. Should the groundwater being removed be determined as contaminated during testing, the contractor shall coordinate the disposal of the contaminated water with the City of St. Joseph.
- C. Pre-installation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to dewatering including, but not limited to, the following:
 - a. Inspection and discussion of condition of site to be dewatered including coordination with temporary erosion control measures and temporary controls and protections.
 - b. Geotechnical report.
 - c. Proposed site clearing and excavations.
 - d. Existing utilities and subsurface conditions.
 - e. Coordination for interruption, shutoff, capping, and continuation of utility services.
 - f. Construction schedule. Verify availability of Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - g. Testing and monitoring of dewatering system.
 - h. Discharge point or discharge plan.
 - i. Testing of effluent.
 - j. Procedures for handling of the contaminated effluent.

1.6 PROJECT CONDITIONS

- A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
 - 1. Notify Owner no fewer than seven days in advance of proposed interruption of utility.
 - 2. Do not proceed with interruption of utility without Owner's written permission.

- B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from this data.
 - 1. Make additional test borings and conduct other exploratory operations necessary for dewatering.
- C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements, establishing exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.
 - 1. During dewatering, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations for comparison with original elevations. Promptly notify Architect if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.
 - 1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site and surrounding area.
 - 2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.
- B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Provide temporary grading to facilitate dewatering and control of surface water.
- D. Monitor dewatering systems continuously.
- E. Promptly repair damages to adjacent facilities caused by dewatering.
- F. Protect and maintain temporary erosion and sedimentation controls, which are specified in Division 31 Section "Site Clearing" during dewatering operations.

3.2 INSTALLATION

- A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.
 - 1. Space well points or wells at intervals required to provide sufficient dewatering.
 - 2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.
- B. Before excavating below ground-water level, place system into operation to lower water to specified levels. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.
- C. Provide an adequate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.
 - 1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.
- D. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
 - 1. Maintain piezometric water level a minimum of 24 inches below surface of excavation.
- E. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.
- F. Provide standby equipment on site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, restore damaged structures and foundation soils at no additional expense to Owner.
 - 1. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches below overlying construction.
- G. Damages: Promptly repair damages to adjacent facilities caused by dewatering operations.

3.3 FIELD QUALITY CONTROL

- A. Observation Wells: Provide, take measurements, and maintain at least the minimum number of observation wells or piezometers indicated; additional observation wells may be required by authorities having jurisdiction.
 - 1. Observe and record daily elevation of ground water and piezometric water levels in observation wells.
 - 2. Repair or replace, within 24 hours, observation wells that become inactive, damaged, or destroyed. In areas where observation wells are not functioning properly, suspend construction activities until reliable observations can be made. Add or remove water from observation-well risers to demonstrate that observation wells are functioning properly.

3. Fill observation wells, remove piezometers, and fill holes when dewatering is completed.
- B. Provide continual observation to ensure that subsurface soils are not being removed by the dewatering operation.

END OF SECTION 31 2319

SECTION 31 5000 - EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes temporary excavation support and protection systems.
- B. Related Sections:
 - 1. Division 01 Section "Temporary Facilities and Controls" for temporary utilities and support facilities.
 - 2. Division 31 Section "Dewatering" for dewatering system for excavations.

1.3 PERFORMANCE REQUIREMENTS

- A. Design, furnish, install, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting soil and hydrostatic pressure and superimposed and construction loads.
 - 1. Delegated Design: Design excavation support and protection system, including comprehensive engineering analysis by a qualified professional engineer in the State of Missouri, using performance requirements and design criteria indicated.
 - 2. Prevent surface water from entering excavations by grading, dikes, or other means.
 - 3. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.
 - 4. Monitor vibrations, settlements, and movements.

1.4 SUBMITTALS

- A. Shop Drawings: For excavation support and protection system.
- B. Delegated-Design Submittal: For excavation support and protection system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer in the State of Missouri responsible for their preparation.
- C. Coordinate first paragraph below with qualification requirements in Division 01 Section "Quality Requirements." Qualification Data: For qualified professional engineer.
- D. Other Informational Submittals:
 - 1. Photographs: Show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by the absence of, the installation of, or the performance of excavation support and protection systems. Submit before Work begins.

2. Record Drawings: Identifying and locating capped utilities and other subsurface structural, electrical, or mechanical conditions.
 - a. Note locations and capping depth of wells and well points.

1.5 QUALITY ASSURANCE

- A. Preinstallation Conference: Conduct conference at Project site.
 1. Review methods and procedures related to excavation support and protection system including, but not limited to, the following:
 - a. Geotechnical report.
 - b. Existing utilities and subsurface conditions.
 - c. Proposed excavations.
 - d. Proposed equipment.
 - e. Monitoring of excavation support and protection system.
 - f. Working area location and stability.
 - g. Coordination with waterproofing.
 - h. Abandonment or removal of excavation support and protection system.
 - i. Coordination with the dewatering system.

1.6 PROJECT CONDITIONS

- A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
 1. Notify Owner no fewer than seven days in advance of proposed interruption of utility.
 2. Do not proceed with interruption of utility without Owner's written permission.
- B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from the data.
 1. Make additional test borings and conduct other exploratory operations necessary for excavation support and protection.
 2. The geotechnical report is included elsewhere in the Project Manual.
- C. Survey Work: Engage a qualified land surveyor or professional engineer in the State of Missouri to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.
 1. During installation of excavation support and protection systems, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Architect if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide materials that are either new or in serviceable condition.
- B. Structural Steel: ASTM A 36/A 36M, ASTM A 690/A 690M, or ASTM A 992/A 992M.
- C. Steel Sheet Piling: ASTM A 328/A 328M, ASTM A 572/A 572M, or ASTM A 690/A 690M; with continuous interlocks.
 - 1. Corners: Site-fabricated mechanical interlock.
- D. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of size and strength required for application.
- E. Shotcrete: Comply with Division 03 Section "Shotcrete" for shotcrete materials and mixes, reinforcement, and shotcrete application.
- F. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.
- G. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- H. Tiebacks: Steel bars, ASTM A 722/A 722M.
- I. Tiebacks: Steel strand, ASTM A 416/A 416M.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.
 - 1. Shore, support, and protect utilities encountered.
- B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Locate excavation support and protection systems clear of permanent construction so that forming and finishing of concrete surfaces are not impeded.
- D. Monitor excavation support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure that excavation support and protection systems remain stable.

- E. Promptly repair damages to adjacent facilities caused by installing excavation support and protection systems.

3.2 SOLDIER PILES AND LAGGING

- A. Install steel soldier piles before starting excavation. Extend soldier piles below excavation grade level to depths adequate to prevent lateral movement. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging. Accurately align exposed faces of flanges to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.
- B. Install wood lagging within flanges of soldier piles as excavation proceeds. Trim excavation as required to install lagging. Fill voids behind lagging with soil, and compact.
- C. Install wales horizontally at locations indicated on Drawings and secure to soldier piles.

3.3 SHEET PILING

- A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock to form a continuous barrier. Accurately place the piling, using templates and guide frames unless otherwise recommended in writing by the sheet piling manufacturer. Limit vertical offset of adjacent sheet piling to 60 inches. Accurately align exposed faces of sheet piling to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment. Cut tops of sheet piling to uniform elevation at top of excavation.

3.4 TIEBACKS

- A. Tiebacks: Drill, install, grout, and tension tiebacks. Test load-carrying capacity of each tieback and replace and retest deficient tiebacks.
 - 1. Test loading shall be observed by a qualified professional engineer responsible for design of excavation support and protection system.
 - 2. Maintain tiebacks in place until permanent construction is able to withstand lateral soil and hydrostatic pressures.

3.5 BRACING

- A. Bracing: Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.
 - 1. Do not place bracing where it will be cast into or included in permanent concrete work unless otherwise approved by Architect.
 - 2. Install internal bracing, if required, to prevent spreading or distortion of braced frames.
 - 3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.6 REMOVAL AND REPAIRS

- A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and bear soil and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities, and utilities.
 - 1. Remove excavation support and protection systems to a minimum depth of 48 inches below overlaying construction and abandon remainder.
 - 2. Fill voids immediately with approved backfill compacted to density specified in Division 31 Section "Earth Moving."
 - 3. Repair or replace, as approved by Architect, adjacent work damaged or displaced by removing excavation support and protection systems.
- B. Leave excavation support and protection systems permanently in place.

END OF SECTION 31 5000

SECTION 32 1216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Missouri "Standard Specifications for Highway Construction", Section 403 "Asphaltic Concrete Pavement", 1999 and latest revisions.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Asphaltic concrete paving.
 - 2. Pavement-marking paint.
- B. Related Sections include the following:
 - 1. Division 312000 Section "Earth Moving" for subbase and base courses.

1.3 DEFINITIONS

- A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

1.4 SYSTEM DESCRIPTION

- A. Provide asphaltic concrete paving materials, workmanship, and other applicable requirements in accordance with the Missouri Department of Transportation (MoDOT) standard specifications.
 - 1. Standard Specification: MoDOT Standard Specifications, Section 403 "Asphaltic Concrete Pavement".
 - 2. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
- B. Job-Mix Designs: For each job mix proposed for the Work.
- C. Qualification Data: For manufacturer.
- D. Material Test Reports: For each paving material.

- E. Material Certificates: For each paving material, signed by manufacturers.
- F. LEED Submittals
 - 1. Recycled Content- Credit MR 4.2: Provide documentation indicating percentages of post-consumer and pre-consumer recycled content by weight per unit of product or assembly containing the product. Indicate the percentage of the dollar value of the recycled content compared to the total dollar value of the product or assembly containing the product.
 - 2. Regional Material- Credit MR 5.2: When the distance to the project site is 500 miles or less, indicate location and distance to project site of extraction, harvesting, recovery, and manufacturing of all materials. Indicate the dollar value of the material cost of the product containing local/regional materials. Where product components are sourced or manufactured in separate locations, provide location and percentage by weight of each component per unit of product.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer.
- B. Regulatory Requirements: Comply with MoDOT Standard Specifications for asphaltic concrete paving work.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.
- B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp or if the following conditions are not met:
 - 1. Prime and Tack Coats: Minimum surface temperature of 60 deg F.
 - 2. Asphaltic Concrete Base Course: Minimum air temperature (measured in the shade) of 40 deg F and rising at time of placement.
 - 3. Asphaltic Concrete Surface Course: Minimum surface temperature of 60 deg F at time of placement.
- B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials, 50 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 AGGREGATES

- A. General: Use materials and gradations that have performed satisfactorily in previous installations.
- B. Aggregates for asphaltic concrete shall conform to the requirements specified in the Missouri Standard Specifications for Highway Construction, Section 403, subsection 403.2 "Material".
- C. Mineral Filler: Limestone dust, Portland cement, or other inert material complying with the Missouri Standard Specifications for Highway Construction, Section 403, subsection 403.2 "Material".

2.2 ASPHALT MATERIALS

- A. Asphalt Cement: Comply with the Missouri Standard Specifications for Highway Construction, Section 403, subsection 403.2 "Material".
- B. Prime Coat: Emulsified asphalt, SS-1h or CSS-1h.
- C. Tack Coat: Emulsified asphalt, SS-1h or CSS-1h diluted in water with one part water to one part emulsified asphalt.
- D. Water: Potable.

2.3 AUXILIARY MATERIALS

- A. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with AASHTO M248, Type N; colors complying with FS TT-P-115F, Type I.
 - 1. Color: Yellow or white, see plans for color.

2.4 MIXES

- A. Asphaltic Concrete as specified in the Missouri Standard Specifications for Highway Construction, Section 403, except as amended:
 - 1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to support paving and imposed loads.
- B. Proof-roll subgrade using a fully loaded, tandem axle dump truck (minimum gross weight of 20 tons) to locate areas that are unstable or that require further compaction.
- C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
 - 1. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.
- B. Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd.. Apply enough material to penetrate and seal but not flood surface. Allow prime coat to cure for 72 hours minimum.
 - 1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
 - 2. Protect primed substrate from damage until ready to receive paving.
- C. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.10 gal./sq. yd..
 - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.3 HOT-MIX ASPHALT PLACING

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
 - 1. Total Pavement thickness shall match existing pavement thickness. Existing pavement thickness to be determined by the Contractor.
 - 2. Place asphaltic concrete base course in lifts not to exceed 4". Total number of courses as necessary to meet existing total pavement thickness minus 2" (surface course).
 - 3. Place 2" asphaltic concrete surface course in single lift.
 - 4. Spread mix within the following temperature ranges:
 - a. Surface Course: 260 deg F to 335 deg F.
 - b. Base Course: 220 deg F to 335 deg F.
 - 5. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes, unless otherwise indicated.
 - 6. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
 - 1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.4 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of hot-mix asphalt course.
 - 1. Clean contact surfaces and apply tack coat to joints.
 - 2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
 - 3. Offset transverse joints, in successive courses, a minimum of 24 inches.
 - 4. Construct transverse joints as described in AI MS-22, "Construction of Hot Mix Asphalt Pavements."
 - 5. Compact joints as soon as asphaltic concrete will bear roller weight without excessive displacement.
 - 6. Compact asphalt at joints to a density within 2 percent of specified course density.
 - a. Surface Course Density: 95% of Field Mold Density
 - b. Base Course Density: 95% of Field Mold Density

3.5 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers.
 - 1. Complete compaction before mix temperature cools to 185 deg F.
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
 - 1. Average Density: 95 percent of reference laboratory density according to AASHTO T 245, but not greater than 100 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while asphaltic concrete is still warm. Continue rolling until roller marks are eliminated and course has attained maximum density.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, Asphaltic Concrete. Compact by rolling to specified density and surface smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.6 INSTALLATION TOLERANCES

- A. Thickness: Compact each course to produce the thickness indicated within the following tolerances:
 - 1. Base Course: Plus or minus 1/2 inch.
 - 2. Surface Course: Plus 1/4 inch, no minus.

- B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
 - 1. Base Course: 1/4 inch.
 - 2. Surface Course: 1/8 inch.
 - 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.7 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 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.

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor shall engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports.
 - 1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from specified requirements.
 - 2. Perform Compaction testing according to Missouri Department of Transportation Specifications Section 203 (203.05) or by pre-approved method. At the Engineer's discretion, one test may be taken daily, but no less than 1 test for each pavement thickness called out in the plans.
 - 3. At the Engineer's discretion, one core may be cut and tested daily for conformance with thickness and/or density requirements. Additional tests, at the contractor's expense, may be necessary to determine limits of areas of deficiency. Equipment to cut cores shall be capable of cutting the mixture without shattering the edges or otherwise disturbing the core. The contractor shall, when necessary, furnish and apply cold water ice, or other cooling substance to the surface of the pavement to prevent the samples from shattering or disintegrating.
- B. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

- C. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.
- D. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- E. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

END OF SECTION 32 1216

SECTION 32 1313 – CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes exterior cement concrete pavement for the following:
 - 1. Driveways and roadways.
 - 2. Curbs and gutters.
 - 3. Walkways.
 - 4. Mow Strip.
- B. Furnish materials, workmanship, and other requirements in accordance with MoDOT standards and specifications except as revised by these plans and specifications.
- C. Related Sections include the following:
 - 1. Division 312000 Section "Earth Moving" for subgrade preparation, grading, and subbase course.
 - 2. Division 321373 Section "Concrete Paving Joint Sealants" for joint sealants within concrete pavement and at isolation joints of concrete pavement with adjacent construction.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, expansive hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.

1.4 SUBMITTALS

- A. Product Data: For each type of manufactured material and product indicated.
- B. Design Mixes: For each concrete pavement mix. Include contingent mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:

- D. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements:
1. Cementitious materials and aggregates.
 2. Steel reinforcement and reinforcement accessories.
 3. Admixtures.
 4. Curing compounds.
 5. Bonding agent or adhesive.
 6. Joint fillers.
- E. LEED Submittals
1. Recycled Content- Credit MR 4.2: Provide documentation indicating percentages of post-consumer and pre-consumer recycled content by weight per unit of product or assembly containing the product. Indicate the percentage of the dollar value of the recycled content compared to the total dollar value of the product or assembly containing the product.
 2. Regional Material- Credit MR 5.2: When the distance to the project site is 500 miles or less, indicate location and distance to project site of extraction, harvesting, recovery, and manufacturing of all materials. Indicate the dollar value of the material cost of the product containing local/regional materials. Where product components are sourced or manufactured in separate locations, provide location and percentage by weight of each component per unit of product.
 3. Solar Reflective Index – Credit SS 7.1: Provide documentation indicating Solar Reflective Index (SRI) of indicated Concrete Mixes is a minimum of 29 as certified by a testing agency.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed pavement work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
1. Manufacturer must be certified according to the National Ready Mix Concrete Association's Plant Certification Program.
- C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant and each aggregate from one source.
- E. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by the requirements of the Contract Documents.
- F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixes.

- G. Codes and Standards: Comply with local governing regulations if more stringent than requirements herein specified.

1.6 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
 - 1. Utilize flagmen, barricades, warning signs and warning lights as required.

PART 2 - PRODUCTS

2.1 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.
 - 1. Use flexible or curved forms for curves of a radius 100 feet or less.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

- A. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
- B. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed.
 - 1. All reinforcement bars for the Helipad concrete shall be epoxy coated per MoDOT Standard Specification Section 1036 "Reinforcing Steel for Concrete, Epoxy Powders", and latest special provision.
- C. Plain Steel Wire: ASTM A 82, as drawn.
- D. Joint Dowel Bars: Plain steel bars, ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends square and free of burrs.
 - 1. All dowel bars for Helipad concrete construction shall be epoxy coated per MoDOT Standard Specification Section 1036 "Reinforcing Steel for Concrete, Epoxy Powders", and latest special provision.
- E. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.
- F. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against pavement form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.
- G. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement bars, welded wire fabric, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast

concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
2. Steel wire and steel supports used in conjunction with epoxy coated steel reinforcement shall be epoxy coated or plastic coated.

2.3 CONCRETE MATERIALS

- A. General: Use the same brand and type of cementitious material from the same manufacturer throughout the Project.
- B. Portland Cement: ASTM C 150, Type I except that total alkalis shall not exceed 0.60 percent.
 1. Fly Ash will be permitted to the proportions defined within this specification.
- C. Fly Ash: ASTM C 618, Class C or Class F
 1. Loss on ignition not to exceed 3.0%
 2. Expansion of the test mixture as a percentage of low alkali cement control at 14 days <120%.
 3. Minimum sampling and testing frequencies per ASTM C 311.
 4. Source of Fly Ash must be on the MoDOT Pre-qualified list.
- D. Aggregate: All aggregates shall conform to the requirements of the City of St. Joseph Standard Specifications, latest edition, except where otherwise provided by these specifications.
- E. Coarse Aggregate: ASTM C 33, uniformly graded from a single source, as follows:
 1. Gravel, crushed gravel, crushed stone or a combination thereof.
 2. The percentage of wear shall not exceed forty percent (40%) as tested by the Los Angeles Abrasion Test Method and the loss shall not be more than eighteen percent (18%) as tested for soundness by the Magnesium Sulfate Method. The soundness requirement shall be waived if aggregate meets all of the requirements for Durability Class I of the KDOT Standard Specification.
 3. Maximum absorption of three and five tenths percent (3.5%).
 4. Grading Requirements shall be size No. 67, 3/4" to No. 4:

Retained on 1" mesh sieve	0%
Retained on 3/4" mesh sieve	0%-10%
Retained on 3/8" mesh sieve	45%-80%
Retained on #4 mesh sieve	90%-100%
Retained on #8 mesh sieve	95%-100%

- F. Fine Aggregate: Fine Aggregate to be used in concrete shall consist of natural sand resulting from the disintegration of siliceous and/or calcareous rocks and manufactured sand produced from crushing predominantly siliceous materials and shall be uniformly graded from coarse to fine. This type of aggregate shall be free from injurious amounts of organic impurities and from injurious amounts of alkali. Other deleterious substances shall not exceed the following percentages by weight:

Material passing No. 200 sieve	2.0
Shale, lignite, coal, soft or flaky fragments	1.0
Sticks (wet)	0.1

Clay lumps (wet, on No. 4 sieve) 0.25

Fine Aggregate shall meet the following gradation requirements when tested as specified by ASTM Method C 136:

Retained on 3/8" sieve	0%
Retained on 3/8" sieve	0%-5%
Retained on 3/8" sieve	0%-20%
Retained on 3/8" sieve	15%-50%
Retained on 3/8" sieve	40%-75%
Retained on 3/8" sieve	70%-95%
Retained on 3/8" sieve	90%-100%

1. The fine aggregate shall have a fineness modulus of not less than 2.50 or more than 3.40 and the percent retained between any two consecutive sieves shall not be more than twenty-five percent (25%).

G. Water: ASTM C 94.

2.4 ADMIXTURES

- A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cement and to be compatible with other admixtures.
- B. Air-Entraining Admixture: ASTM C 260.
- C. Water-Reducing Admixture: ASTM C 494, Type A.

2.5 CURING MATERIALS

- A. A liquid membrane-forming curing compound shall be used for all applications, unless otherwise specified by the Engineer. The compound shall conform to the requirements for Type 2, white Pigmented Compound as specified in AASHTO M 148 and to the requirements of ASTM C 309.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. All newly placed concrete shall be cured immediately after finishing for a minimum of 7 days unless otherwise specified or approved by the Engineer. Formed surfaces shall be cured if forms are removed prior to 7 days after concrete placement.

2.6 AGGREGATE BASE COURSE

- A. Aggregate Base Course shall consist of ASTM C33 Size No. 57 aggregate or similar in accordance with Section 304 "Aggregate Base Course" of the MoDOT standard specifications.
- B. Aggregate Base shall be constructed in accordance with MoDOT Section 1007 "Aggregate for Base" of the MoDOT standard specifications.
- C. Aggregate Base thickness to meet the specified minimum thickness indicated on the plans.

- D. Aggregate Base shall extend 1 foot outside of the back of curb or 1' outside of the edge of concrete pavement.

2.7 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751 and AASHTO M 213, non-extruding and resilient filler.
- B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

2.8 CONCRETE MIXES

- A. The concrete mixture shall be formulated such that the hardened/cured concrete shall have a solar reflectance index of at least 29.
- B. Prepare design mixes, proportioned according to ACI 211.1 and ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.
- C. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the trial batch method.
 - 1. Do not use Owner's field quality-control testing agency as the independent testing agency.
- D. Proportion mixes to provide concrete with the following properties:
 - 1. Compressive Strength (28 Days): 4000 psi .
 - 2. Maximum Water-Cementitious Materials Ratio: 0.48.
 - 3. Slump Limit: 3 inches.
- E. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements for concrete exposed to deicing chemicals.
 - 1. Fly Ash shall be Type C or Type F with a minimum of 20% and a maximum of 25% by unit weight.
- F. Design Mixtures for Credit ID 1: For each concrete mixture containing fly ash as a replacement for portland cement or other portland cement replacements. For each design mixture submitted, include an equivalent concrete mixture that does not contain portland cement replacements, to determine amount of portland cement replaced.
- G. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content as follows within a tolerance of plus or minus 2 percent:
 - 1. Air Content: 6.0 percent.

2.9 CONCRETE MIXING

- A. Ready-Mixed Concrete: Comply with requirements and with ASTM C 94.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Proof-roll prepared subbase surface to check for unstable areas and verify need for additional compaction. Proceed with pavement only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.
- B. Remove loose material from compacted subbase surface immediately before placing concrete.

3.2 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form release agent to ensure separation from concrete without damage.

3.3 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating reinforcement and with recommendations in CRSI's "Placing Reinforcing Bars" for placing and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.4 JOINTS

- A. General: Construct construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.
 - 1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour, unless pavement terminates at isolation joints.
 - 1. Provide preformed galvanized steel or plastic keyway-section forms or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
 - 2. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
 - 3. Provide tie bars at sides of pavement strips where indicated.
 - 4. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
1. Locate expansion joints at ends of curb returns and changes in curb direction.
 2. Extend joint fillers full width and depth of joint.
 3. Terminate joint filler less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
 6. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Install dowel bars and support assemblies at joints where indicated. Paint and grease approx. three-fifths of dowel length to prevent concrete bonding to one side of joint.
1. Alternate ends of dowels in baskets to be painted and greased.
- E. 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, as follows:
1. Space joints at fifteen (15') feet maximum or as noted on the plan set.
 2. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with groover tool to the following radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.
 - a. Radius: 1/4 inch.
 3. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
- F. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to the following radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.
1. Radius: 1/4 inch.

3.5 CONCRETE PLACEMENT

- A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcement steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.
- B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.

- C. Moisten subbase to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.
- D. Comply with requirements and with recommendations in ACI 304R for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery, at Project site, or during placement.
- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Consolidate concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures to consolidate concrete according to recommendations in ACI 309R.
 - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.
- H. Install reinforcement as per one of the following methods:
 - 1. Place concrete in two operations; strike off initial pour for entire width of placement and to the required depth below finish surface. Lay welded wire fabric or fabricated bar mats immediately in final position. Place top layer of concrete, strike off, and screed.
 - a. Remove and replace portions of bottom layer of concrete that have been placed more than 15 minutes without being covered by top layer, or use bonding agent if approved by Engineer.
 - 2. Set welded wire fabric or fabricated bar mats on bar supports as specified in this section or concrete blocks of required height.
- I. Screed pavement surfaces with a straightedge and strike off. Commence initial floating using bull floats or darbies to form an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading dry-shake surface treatments.
- J. Curbs and Gutters: When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not approved, remove and replace with formed concrete.
- K. Slip-Form Pavers: When automatic machine placement is used for pavement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce pavement to required thickness, lines, grades, finish, and jointing as required for formed pavement.
 - 1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of paver machine during operations.
- L. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength.

- M. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
 2. Do not use frozen materials or materials containing ice or snow.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.
- N. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows when hot-weather conditions exist:
1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg F. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Cover reinforcement steel with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 3. Fog-spray forms, reinforcement steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.6 CONCRETE FINISHING

- A. General: Wetting of concrete surfaces during screeding, initial floating, or finishing operations is prohibited.
- B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and the 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. Re-float 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.
 - a. Broom finish not applicable to curb & gutter

3.7 CONCRETE PROTECTION 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 follow recommendations in ACI 305R for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Begin curing after finishing concrete, but not before free water has disappeared from concrete surface.

- D. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:
1. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 2. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.8 PAVEMENT TOLERANCES

- A. Comply with tolerances of ACI 117 and as follows:

1. Elevation: 1/4 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-foot- long, unlevelled straightedge not to exceed 1/4 inch.
4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch.
6. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch.
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches.
8. Joint Spacing: 6 inches.
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

- B. Aggregate Base

1. Elevation: No Plus Allowed, Minus 1/2 inch
2. Thickness: Plus 1/2 inch, No Minus Allowed

3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor will engage a qualified testing and inspection agency to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include those specified in this Article.
- 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. Slump: ASTM C 143; one test at point of placement for each compressive-strength test, but not less than one test for each day's pour of each type of concrete. Additional tests will be required when concrete consistency changes.
 3. 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.
 4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each set of compressive-strength specimens.
 5. Compression Test Specimens: ASTM C 31/C 31M; one set of four standard cylinders for each compressive-strength test, unless otherwise indicated. Cylinders shall be molded

and stored for laboratory-cured test specimens unless field-cured test specimens are required.

6. Compressive-Strength Tests: ASTM C 39; one set for each day's pour of each concrete class exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd.. One specimen shall be tested at 7 days and two specimens at 28 days; one specimen shall be retained in reserve for later testing if required.
 7. When frequency of testing will provide fewer than five compressive-strength tests for a given class of concrete, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 8. When total quantity of a given class of concrete is less than 50 cu. yd., Architect may waive compressive-strength testing if adequate evidence of satisfactory strength is provided.
 9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, current operations shall be evaluated and corrective procedures shall be provided for protecting and curing in-place concrete.
 10. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive compressive-strength test results equal or exceed specified compressive strength and no individual compressive-strength test result falls below specified compressive strength by more than 500 psi.
- C. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 24 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing agency, concrete type and class, location of concrete batch in pavement, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- D. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as the sole basis for approval or rejection.
- E. Additional Tests: Testing agency shall make additional tests of the concrete when test results indicate slump, air entrainment, concrete strengths, or other requirements have not been met, as directed by Architect. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.

3.10 REPAIRS AND PROTECTION

- A. Remove and replace concrete pavement that is broken, damaged, or defective, or does not meet requirements in this Section.
- B. Drill test cores where directed by Architect when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.
- C. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for inspections.

END OF SECTION 32 1313

SECTION 32 1373 – CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Expansion and contraction joints within portland cement concrete pavement.
- B. Furnish materials, workmanship, and other applicable requirements in accordance with MoDOT standards and specifications except as revised by these plans and specifications.
- C. Related Sections include the following:
 - 1. Division 32 Section "Concrete Paving" for constructing joints in concrete paving.

1.3 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Product Certificates: Signed by manufacturers of joint sealants certifying that products furnished comply with requirements and are suitable for the use indicated.
- C. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.

- B. Store and handle materials to comply with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 deg F.
 - 2. When joint substrates are wet.
- B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than that allowed by joint sealant manufacturer for application indicated.
- C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint sealant manufacturer based on testing and field experience.
- B. Colors of Exposed Joint Sealants: Match Architect's samples or as selected by Architect from manufacturer's full range for this characteristic.
- C. Joint Filler: For expansion joints, filler shall be preformed joint filler conforming to ASTM Designation D1751.

2.2 HOT-APPLIED JOINT SEALANTS

- A. All joints shall be sealed with hot-pour type joint sealant meeting the requirements of ASTM 1190.

2.3 JOINT-SEALANT BACKER MATERIALS

- A. General: Provide joint-sealant backer materials that are non-staining and heat resistant; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint sealant manufacturer based on field experience and laboratory testing.
- B. The backer rod shall be resilient closed or open cell polyethylene foam rod as recommended by the manufacturer of the sealant. It shall be compatible with the silicone sealant and no bond or reaction shall occur between the rod and the sealant.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- 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.
- B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint sealant manufacturer's written installation instructions applicable to products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install backer materials of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of backer materials.
 - 2. Do not stretch, twist, puncture, or tear backer materials.
 - 3. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.
- D. Install sealants by proven techniques to comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses provided for each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Provide joint configuration to comply with joint sealant manufacturer's written instructions, unless otherwise indicated.
- F. Provide recessed joint configuration for silicone sealants of recess depth and at locations indicated.

3.4 CLEANING

- A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from the original work.

END OF SECTION 32 1373

SECTION 329200 – TURF AND GRASSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:

- 1. Seeding.
- 2. Sodding.

1.3 DEFINITIONS

- A. Finish Grade: Elevation of finished surface of planting soil.
- B. Manufactured Soil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- C. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.
- D. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill immediately beneath planting soil.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name and percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
 - 1. Certification of each seed mixture for turfgrass sod, identifying source, including name and telephone number of supplier.
- C. Planting Schedule: Indicating anticipated planting dates for each type of planting.
- D. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of lawns during a calendar year. Submit before expiration of required maintenance periods.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful lawn establishment.
 - 1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when planting is in progress.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Seed: Deliver seed in original sealed, labeled, and undamaged containers.
- B. Sod: Harvest, deliver, store, and handle sod according to requirements in TPI's "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in its "Guideline Specifications to Turfgrass Sodding."

1.7 SCHEDULING

- A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.
 - 1. Spring Planting: February 15th -April 30th
 - 2. Fall Planting: August 15th – September 30th
 - 3. Air temperatures must be between 13-27 degrees Celsius (55-80 F).
 - 4. Seeding seasons can be extended a few days when mulching is specified to follow seeding and fertilizing.
 - 5. The Architect has the right to vary the seeding seasons shown above due to weather or soil conditions or for other causes.
- B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit.

1.8 LAWN MAINTENANCE

- A. Begin maintenance immediately after each area is planted and continue until acceptable lawn is established, but for not less than the following periods:
 - 1. Seeded Lawns: **60** days from date of Substantial Completion.
 - a. When full maintenance period has not elapsed before end of planting season, or if lawn is not fully established, continue maintenance during next planting season.
 - 2. Sodded Lawns: **30** days from date of Substantial Completion.
- B. Maintain and establish lawn by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth lawn.
 - 1. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch. Anchor as required to prevent displacement.

- C. Watering: Provide and maintain temporary piping, hoses, and lawn-watering equipment to convey water from sources and to keep lawn uniformly moist to a depth of 4 inches (100 mm).
 - 1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
 - 2. Water lawn at a minimum rate of 1 inch (25 mm) per week.
- D. Mow lawn as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 40 percent of grass height. Remove no more than 40 percent of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:
 - 1. Mow grass 2 to 3 inches (50 to 75 mm) high.
- E. Lawn Postfertilization: Apply fertilizer after initial mowing and when grass is dry.
 - 1. Use fertilizer that will provide actual nitrogen of at least 1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m) to lawn area.

PART 2 - PRODUCTS

2.1 SEED

- A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.
- B. Seed Species: Seed of grass species as follows, with not less than **95** percent germination, not less than **85** percent pure seed, and not more than **0.5** percent weed seed:
 - a. Turf Type Tall Fescue blend

2.2 TURFGRASS SOD

- 1. Turfgrass Sod: **Certified** – Turf Type Tall Fescue blend

2.3 TOPSOIL (if needed)

- A. Topsoil: ASTM D 5268, pH range of 5.5 to 7, a minimum of 2 percent organic material content; free of stones 1 inch (25 mm) or larger in any dimension and other extraneous materials harmful to plant growth.
 - 1. Topsoil Source: Reuse surface soil stockpiled on-site. Verify suitability of stockpiled surface soil to produce topsoil. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
 - a. Supplement with imported or manufactured topsoil from off-site sources when quantities are insufficient. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches (100 mm) deep; do not obtain from bogs or marshes.

2. Topsoil Source: Import topsoil or manufactured topsoil from off-site sources. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches (100 mm) deep; do not obtain from bogs or marshes.
 3. Topsoil Source: Amend existing in-place surface soil to produce topsoil. Verify suitability of surface soil to produce topsoil. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
- B. Surface soil may be supplemented with imported or manufactured topsoil from off-site sources. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches (100 mm) deep.

2.4 PLANTING ACCESSORIES

- A. Selective Herbicides: EPA registered and approved, of type recommended by manufacturer for application.

2.5 FERTILIZER

- A. 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: 1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m) of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.

2.6 MULCHES

- A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.
- B. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic; free of plant-growth or germination inhibitors; with maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.
- C. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

2.7 EROSION-CONTROL MATERIALS

- A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches (150 mm) long.
- B. Provide one of the following or an approved equivalent:
- a) High Velocity Curlex Blanket by American Excelsior Company.
 - b) Soil Guard bonded fiber matrix by Weyerhaeuser, Snoqualmie, WA
 - c) Excelsior Standard Erosion control blanket by Contech Construction Products, Middletown, OH
- C. Submit sample and specifications to the Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive lawns and grass for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
 - 1. Protect adjacent and adjoining areas from hydroseeding overspray.
 - 2. Existing plant materials indicated for removal are to be disposed off-site.
 - 3. All undesirable perennial grasses and weeds such as Bermuda grass, Yellow Nutsedge, Field Bindweed, and others found in such landscape beds and in all lawn areas to be established shall be treated and killed out with Roundup or other approved herbicide at label rates, prior to installation.
- B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 LAWN PREPARATION

- A. Limit lawn subgrade preparation to areas to be planted.
- B. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 4 inches (100 mm). Remove stones larger than 2 inches (50 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
- C. Unchanged Subgrades: If lawns are to be planted in areas unaltered or undisturbed by excavating, grading, or surface soil stripping operations, prepare surface soil as follows:
 - 1. Remove existing grass, vegetation, and turf. Do not mix into surface soil.
 - 2. Loosen surface soil to a depth of at least of 4 inches. Apply soil amendments and fertilizers according to planting soil mix proportions and mix thoroughly into top 4 inches (100 mm) of soil. Till soil to a homogeneous mixture of fine texture.
 - a. Apply 13-13-13 fertilizer directly to surface soil before loosening.
 - 3. Remove stones larger than 2 inches (50 mm) in any dimension and sticks, roots, trash, and other extraneous matter.
 - 4. Legally dispose of waste material, including grass, vegetation, and turf, off Owner's property.
- D. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch (13 mm) of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas that can be planted in the immediate future.

- E. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- F. Restore areas if eroded or otherwise disturbed after finish grading and before planting.

3.4 SEEDING

- A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph (8 km/h). Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
 - 1. Do not use wet seed or seed that is moldy or otherwise damaged.
- B. Sow seed at the rate of 10 lb/1000 sq. ft.
- C. Rake seed lightly into top 1/8 inch (3 mm) of topsoil, roll lightly, and water with fine spray.
- D. Protect seeded areas with slopes exceeding 1:4 with erosion-control blanket installed and stapled according to manufacturer's written instructions.
- E. Protect seeded areas with slopes not exceeding 1:4 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre (42 kg/92.9 sq. m) to form a continuous blanket 1-1/2 inches (38 mm) in loose depth over seeded areas. Spread by hand, blower, or other suitable equipment.
 - 1. Anchor straw mulch by crimping into topsoil with suitable mechanical equipment.
- F. Protect seeded areas from hot, dry weather or drying winds by applying mulch within 24 hours after completing seeding operations. Soak and scatter uniformly to a depth of 3/16 inch (4.8 mm) and roll to a smooth surface.

3.5 HYDROSEEDING

- A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.
 - 1. Mix slurry with nonasphaltic tackifier.
 - 2. Apply slurry uniformly to all areas to be seeded in a one-step process. Apply mulch at a minimum rate of 1500-lb/acre (15.3-kg/92.9 sq. m) dry weight but not less than the rate required to obtain specified seed-sowing rate.

3.6 SODDING

- A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.
- B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.

1. Lay sod across angle of slopes exceeding 1:3.
 2. Anchor sod on slopes exceeding 1:6 with wood pegs spaced as recommended by sod manufacturer but not less than 2 anchors per sod strip to prevent slippage.
- C. Saturate sod with fine water spray within 30 minutes planting. During first week, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches (38 mm) below sod.

3.7 SATISFACTORY LAWNS

- A. Satisfactory Seeded Lawn: 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. (0.92 sq. m) and bare spots not exceeding 5 by 5 inches (125 by 125 mm).
- B. Satisfactory Sodded Lawn: At end of maintenance period, a healthy, well-rooted, even-colored, viable lawn has been established, free of weeds, open joints, bare areas, and surface irregularities.
- C. Reestablish lawns that do not comply with requirements and continue maintenance until lawns are satisfactory.

3.8 CLEANUP AND PROTECTION

- A. Promptly remove soil and debris created by lawn work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Erect barricades and warning signs as required to protect newly planted areas from traffic. Maintain barricades throughout maintenance period and remove after lawn is established.
- C. Remove any non-biodegradable erosion-control measures after grass establishment period.

END OF SECTION 329200

SECTION 33 4100 - STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes gravity-flow, non-pressure storm drainage outside the building, with the following components:
 - 1. Cleanouts.
 - 2. Precast concrete manholes.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For manholes and catch basins. Include plans, elevations, sections, details, and manhole frames and covers and catch basin frames and grates.
- C. Field quality-control test reports. Product Data: For each type of product indicated.

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 PE PIPE AND FITTINGS

- A. Corrugated High Density Polyethylene (HDPE) Drainage Pipe and Fittings NPS 10 and Smaller: AASHTO M 252M, Type S, with smooth waterway for coupling joints.
 - 1. Soiltight Couplings: AASHTO M 252M, corrugated, matching tube and fittings.
- B. Corrugated HDPE Pipe and Fittings NPS 12 and Larger: AASHTO M 294M, Type S, with smooth waterway for coupling joints.

1. Soiltight Couplings: AASHTO M 294M, corrugated, matching pipe and fittings.

C. Pipe shall have integral wall bell and spigot joint with gaskets conforming to ASTM F477. Natural Rubber gaskets will not be accepted.

2.3 REINFORCED CONCRETE PIPE AND FITTINGS

A. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76, Class III, Wall "C" or the latest revision thereof.

1. The end joints shall be either bell and spigot or tongue and groove. For all pipe both ends of the pipe shall be concentric with the base of the pipe and they shall be smooth, true and free from spalls and other defects and shall be formed in such a manner to insure accuracy and roundness between pipe and manhole. The connectors clamped to pipes and grouted into manhole walls must be used as rigid connections.

a. Gaskets: ASTM C 443, rubber

2.4 ALUMINIZED STEEL (CORRUGATED METAL)

A. Type 2 Corrugated Steel Pipe and fittings: AASHTO M 36. US Standard Gage for corrugated steel pipe shall be in accordance with the Standard Detail Drawings. Joints shall be either Hugger-type or Bell and Spigot.

1. Bell and Spigot Joints. Shall conform to "CONTECH Quick Stab Joint", or equal 18" through 48" diameter.
2. Hugger-type Joints. Shall conform to "CONTECH HUGGER Band", or equal for pipes sizes 15" and larger.

2.5 PVC PIPE AND FITTINGS

A. PVC Sewer Pipe and Fittings: According to the following:

1. The pipe shall be made of PVC plastic having a cell classification of 12454-B or 12454-C as defined in ASTM D 1784.
2. Push-on joints shall conform to ASTM D 3212 and gaskets to ASTM F 477. Solvent cements for joining pipe and socket-type fittings shall conform to ASTM D 2564.

B. PVC Sewer Pipe and Fittings, 4 in. and 6 in: ASTM D 2665 (Schedule 40 wall thickness)

C. PVC Sewer Pipe and Fittings, 8" through 15": ASTM D 3034, SDR 35.

D. PVC Sewer Pipe and Fittings, 18" and Larger: ASTM F 679, PS-46.

2.6 CLEANOUTS

A. Gray-Iron Cleanouts: 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.

1. Available Manufacturers:
 - a. Josam Company.
 - b. MIFAB Manufacturing Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Wade Div.; Tyler Pipe.
 - e. Watts Industries, Inc.
 - f. Watts Industries, Inc.; Enpoco, Inc. Div.
 - g. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
 2. Top-Loading Classification: Heavy duty.
 3. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.
- B. PVC Cleanouts: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.
1. Available Manufacturers:
 - a. Canplas Inc.
 - b. IPS Corporation.
 - c. NDS Inc.
 - d. Plastic Oddities, Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Zurn Light Commercial Specialty Plumbing Products; Zurn Plumbing Products Group.

2.7 MANHOLES

- A. Standard Precast Concrete Manholes: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
1. Diameter: 48 inches minimum, unless otherwise indicated.
 2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
 3. Base Section: 8-inch minimum thickness for floor slab and minimum of one-twelfth (1/12) of the internal shell diameter plus one inch (1") or five inches (5") minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
 4. Riser Sections: minimum of one-twelfth (1/12) of the internal shell diameter plus one inch (1") or five inches (5") minimum thickness, and of length to provide depth indicated.
 5. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
 6. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
 7. All interior surfaces of precast concrete manholes shall receive a troweled or broomed grout finish to fill air holes and irregularities prior to applying the epoxy coatings. The interior surfaces shall be coated with two coats of Tnemec Series 66 Hi-Build epoxy or other approved equal. When the paint coating is applied by the manufacturer, surfaces which are to be grouted or patched shall not be painted until after assembly of the manhole. The contractor shall apply epoxy to touch up damaged surfaces and cover patches or grouted areas. Each application of epoxy coating shall have a minimum dry film thickness of 4 mils.
 8. All grout used to close openings around waterstop gaskets and sewer pipes shall contain approved non-metallic shrinkage correcting aggregate.
 9. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.

- a. Cast-In Resilient Connectors Type cast into manhole wall at the manufacturing facility. The connection is completed by inserting end of pipe through connector. Connector shall be A-Lok or approved equal.
 - b. For connection to an existing structure only: Type clamped around end of pipe and grouted into opening in manhole wall. Connector shall be G3 Boot System featuring component packaging as manufactured by A-LOK Products, Inc. or approved equal. Non-shrink grout must be used.
10. Steps: 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.
- a. Cast Iron Steps shall be Vestal Manufacturing No. 918-P, Clay & Bailey No. 2115, Neenah No. R-1981-1 or equal.
 - b. Copolymer Polypropylene Plastic Step, PS1-PF or PS2-PF Manufactured by M.A. Ind., Inc. or approved equal.
11. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.
12. Grade Rings: Reinforced-concrete rings, 3- to 6-inch total thickness, to match diameter of manhole frame and cover.
- B. Manhole Frames and Covers: ASTM A 48, Class 35B or higher, except as modified or supplemented herein, ductile-iron castings designed for heavy-duty service. Include 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 "SANITARY SEWER" cast into cover. All frames shall be bolted to the concrete manhole wall. All covers shall be bolted to the manhole frame.
1. Manhole frames and covers shall be manufactured so as to be fully interchangeable. All of the covers provided shall be suitable for installation on any of the frames provided and shall not rock or tip under an applied load.
 2. All castings imported into the United States shall conform to the applicable provisions of the United States Customs regulations.
 3. Bolt-down type manhole rings shall be anchored to the manhole walls with not less than four (4) three-fourths (3/4) inch diameter steel bolts embedded a minimum of fourteen (14) inches, except where the entire ring is embedded in a concrete top slab.
 4. (4) Rings and bolt-down covers shall be provided with machined surfaces, O-ring gaskets and five-eighths (5/8) inch pent-head brass cover bolts. Cover bolt heads shall fit flush or below the top of the cover. The O-ring rubber gasket shall be neoprene or other synthetic, sixty (60) plus or minus five (5) hardness when measured by ASTM D 2240 type durometer.

2.8 STORMWATER INLETS

- A. Standard Precast Concrete Catch Basins: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
1. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
 2. Top Section: Eccentric-cone type unless flat-slab-top type is indicated.
 3. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
- B. Frames and Grates: ASTM A 36, Grade 60-40-18, Steel.

1. Bolt-down type manhole rings shall be anchored to the manhole walls with not less than four (4) three-fourths (3/4) inch diameter steel bolts embedded a minimum of fourteen (14) inches, except where the entire ring is embedded in a concrete top slab.
2. (4) Rings and bolt-down covers shall be proved with machined surfaces, O-ring gaskets and five-eighths (5/9) inch hex head brass cover bolts. Cover bolt heads shall fit flush or below the top of the cover. The O-ring rubber gasket shall be neoprene or other synthetic, sixty (60) plus or minus five (5) hardness when measured by ASTM D 2240 type durometer.

2.9 CONCRETE

- A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:
 1. Cement: ASTM C 150, Type II.
 2. Fine Aggregate: ASTM C 33, sand.
 3. Coarse Aggregate: ASTM C 33, crushed gravel.
 4. Water: Potable.
- B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water-cementitious ratio.
- C. Structure Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water-cementitious ratio.
 1. Include channels and benches in manholes.
 - a. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to one-half of pipe diameter. Form curved channels with smooth, uniform radius and slope.
 - 1) Invert Slope: 2 percent through manhole (min.) or as indicated on drawings.
 - b. Benches: Concrete, sloped to drain into channel.
 - 1) Slope: 4 percent.
 2. Include channels in storm sewer inlets.
 - a. 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.
 - 1) Invert Slope: 2 percent through inlet (min.) or as indicated on drawings.
- D. Ballast and Pipe Supports: Portland cement design mix, 3000 minimum, with 0.58 maximum water-cementitious ratio.
 1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
- E. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.
 1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
 2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

2.10 ENGINEERED PVC SURFACE DRAINAGE PRODUCTS

- A. General: PVC surface drainage inlets shall include the drain basin type as indicated on the contract drawings and referenced within these specifications. The cast iron grates for each of these fittings are to be considered an integral part of the surface drainage inlet and shall be furnished by the same manufacturer. The surface drainage inlets shall be as manufactured by Nyloplast, a division of Advanced Drainage Systems, Inc. or prior approved equal.
- B. Materials
1. The drain basins required for this contract shall be manufactured from PVC pipe stock, utilizing a thermo-molding process to reform the pipe stock to the specified configuration. The drainage pipe connection stubs shall be manufactured from PVC pipe stock and formed to provide a watertight connection with the specified pipe system. This joint tightness shall conform to ASTM D3212 for joints for drain and sewer plastic pipe using flexible elastomeric seals. The pipe bell spigot shall be joined to the main body of the drain basin. The pipe stock used to manufacture the main body and pipe stubs of the surface drainage inlets shall meet the mechanical property requirements for fabricated fittings as described by ASTM D3034, Standard for Sewer PVC Pipe and Fittings; ASTM F1336, Standard for PVC Gasketed Sewer Fittings.
 2. The grates furnished for all surface drainage inlets shall be ductile iron grates for sizes 8", 10", 12", 15", 18", 24" and 30" (12" and 15" frames are cast iron) shall be made specifically for each basin so as to provide a round bottom flange that closely matches the diameter of the surface drainage inlet. Grates for drain basins shall be capable of supporting H-25 wheel loading for heavy-duty traffic or H-10 loading for pedestrian traffic. 12" and 15" grates will be hinged to the frame using pins. Metal used in the manufacturing of the castings shall conform to ASTM A536 grade 70-50-05 for ductile iron and ASTM A-48-83 class 30B for 12" and 15" cast iron frames. Grates shall be provided painted black.
- C. Installation
1. The specified PVC surface drainage inlet shall be installed using conventional flexible pipe backfill materials and procedures. The backfill material shall be crushed limestone or other granular material meeting the requirements of class 1 or 2 material as defined in ASTM D2321. The surface drainage inlets shall be bedded and backfilled uniformly in accordance with ASTM D2321. The drain basin body will be cut at the time of the final grade so as to maintain a one piece, leak proof structure. No brick, stone or concrete block will be used to set the grate to the final grade height. For H-25 Load rated installations, an 8" to 10" thick concrete ring will be poured under the grate and frame as recommended by details provided by the manufacturer.

2.11 PIPE OUTLETS

- A. Head Walls: Cast-in-place reinforced concrete, with apron and tapered sides.
- B. End Sections: Unless shown otherwise, provide standard end sections follows:
1. Standard Precast Concrete for pipe size indicated.
 2. Standard Corrugated Steel End Section with protective coating for pipe size indicated.
 3. Provide Riprap at each end section in accordance to plans.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Division 2 Section "Trenching, Backfill and Compaction."
1. Backfilling Prior to Approvals: Do not allow or cause any of the work performed or installed to be covered up or enclosed by work of this section prior to all required inspections, tests and approvals. Should any of the work be so enclosed or covered up before it has been approved, uncover all such work at no additional cost to the Owner.
- B. General: This section covers excavation, trenching, backfilling and grading incidental to the construction of sewers, pipelines and structures shown on the Drawings and described in these Specifications. Unless specifically shown or designated otherwise, all excavation shall be by open cut. The Contractor shall assume full responsibility for satisfactory performance of the work and for the safety of the work, working personnel and the general public.
1. Excavation
- a. Structure Excavation: Excavation for structures shall be to lines and grades shown on the Drawings. Extend excavation for formed structures sufficiently to permit construction and inspection of forms, and for installation of drain tile or other below-grade work. The excavation shall be maintained in a condition suitable for placing reinforcing steel and concrete by such dewatering of adjacent and underlying soil as may be required. Dewatering equipment and methods shall be approved by the Engineer. Approved dewatering equipment may be used within the structure provided that any openings in walls or floors shall subsequently be closed watertight, using methods and procedures approved in advance by the Engineer. Excavation shall be shored and braced to protect adjacent structures or installations from damage. Before placing any concrete, excavation shall be inspected and approved by the Engineer.
- b. Structure Subgrade: A normal foundation under structures will be undisturbed soil. If over excavation occurs or is required, the subgrade may be brought back to grade using approved material from excavation or borrow sources, uniformly compacted as specified for "Type A" compaction. Unless over-excavation of structure subgrade is authorized by Engineer, the corrective action shall be at Contractor expense. Alternatives to the above corrective method are:
- 1) Using the bedding material specified in Paragraph h.
2) Increasing the thickness of the concrete base.
- c. Trench Excavation: Trench excavation shall be to the lines and grades indicated on the drawings. Banks shall be vertical from bottom of the trench to at least 6 inches above the top of the pipe. Above that point, trench wall may be sloped as required for safety and shall conform to all pertinent OSHA Regulations. Trenches shall be excavated as near as is practical to the widths shown on the applicable Standard Sewer Detail sheet of the Drawings. The bottom of the trench shall be undisturbed soil smoothed to the satisfaction of the Engineer by backhoe bucket or hand shovel, or both, prior to placement of bedding material. Dewatering, when required, shall be subsidiary to other bid items.
- d. Rock Excavation: Trench width used in computing rock excavation shall be the width shown on the applicable Standard Sewer Detail sheet of the Drawings. Rock

excavation shall include the excavation of all sedimentary, igneous and metamorphic rock which is naturally in place and is firm, rigid and unweathered and all boulders or other detached stone with a volume of 2 cubic yards or more. Rock encountered in two or more ledges with interlaying strata of soil, clay, gravel or shale not more than 12 inches in thickness between each ledge will be classified as solid rock from the top of the top ledge to the bottom of the bottom ledge of rock. Rock shall be excavated to a depth of not less than 4 inches below the bottom of structures or of sewer pipe and 12 inches below the bottom of finished subgrade for pavement construction.

- e. **Sheeting and Bracing:** Sheeting and bracing shall be provided in all trenches where required and shall conform to all pertinent OSHA Regulations. Sheeting may be wood or metal. Wherever, because of unstable trench conditions, it is necessary to drive sheeting below the centerline of pipe, it shall be driven to a depth of 2 feet (minimum) below the flowline of the pipe. After the trench has been backfilled up to a level 1 foot above the pipe, sheeting may be removed and the space left because of such removal shall be filled immediately and the backfill re-compacted. Wood sheeting which has been driven to below the centerline of the pipe shall be left in place below a level of 1 foot above the top of the pipe. Trench boxes or shields may be used instead of sheeting and bracing.
- f. **Control of Ground Water and Surface Water:** Where ground water or surface water is encountered, trenches shall be dewatered as necessary to permit the construction to be carried on in a satisfactory manner. Portions of sewers where all joints have been completed may be used for draining trenches, provided such drainage is free from debris. Drainage may be collected in temporary sumps and then pumped into natural drainage channels as approved by the Engineer. Surface water shall be prevented from entering trenches. Where approved by the Engineer, and approved in writing by the property owner, existing drainage channels may be temporarily diverted. After completion of the construction, the temporary channels and original channels shall be returned to their original condition unless otherwise approved by the property owner. It shall be the contractor's responsibility to obtain the permission of the property owner, in writing, for the temporary channels.
- g. **Stabilizing Trench Bottoms and Structure Subgrade:** Wet or unstable trench bottoms and structure subgrade shall be stabilized by excavating to additional depth as directed by the Engineer and replacing the unsatisfactory soil with crushed limestone with angular shapes for high interlocking capability graded as follows. Field conditions shall be the determining factor for individual or combined use of these materials. The upper 2 inches of any stabilized area shall consist of specification bedding material. In sewer trenches, the minimum depth of bedding material shall be 4 inches under the pipe.
 - 1) 4 inch to 8 inch primary crusher run.
 - 2) 3 inch to 4 inch crusher run.
 - 3) 1 ½ inch poorly graded.
 - 4) ¾ inch poorly graded.
 - 5) Specification bedding material.
- h. **Bedding Material and Placement:** Bedding material shall be placed and compacted as specified for "Type A" compaction. Trenches shall be excavated to a depth not less than 4 inches below the bottom of the pipe and the pipe shall be laid on a bed of crushed limestone having the follow characteristics unless otherwise shown on the plans:

- 1) Retained on $\frac{3}{4}$ inch sieve: 0%.
- 2) Retained on $\frac{1}{2}$ inch sieve: 24% to 35%.
- 3) Retained on $\frac{3}{8}$ inch sieve: 40% to 60%.
- 4) Retained on No. 4 sieve: 90% to 100%.
- 5) Deleterious Substances, maximum: 5%.

2. Backfill

- a. General: Prior to the placement of either structure backfill or trench backfill, a Standard Proctor Curve as determined by AASHTO T 99 (ASTM D 698) shall be obtained for each type of backfill material to be used. Proctor curves shall be obtained from soil samples selected by a certified testing laboratory from materials excavated by the Contractor. All costs associated with the selection of soil samples and performing the necessary tests to obtain the Proctor curves shall be paid by the Contractor. Selection of the correct Proctor curve for a particular backfill material shall also be done by the Contractor's certified testing laboratory. During backfill operations, soil density tests shall be taken by the Engineer or his representative. When results indicate that compaction does not meet the requirements of these Specifications, the material shall be removed and replaced or re-compacted as necessary to meet the specified requirements at no additional expense to the Owner. Additional tests shall be performed on re-compacted area to insure compliance with the requirements.
- b. Recommendations for Compaction Equipment: Most manufacturers of compaction equipment provide information for the use of their equipment. For compaction of cohesive soils such as clay or clay-silt mixes, the recommended equipment includes rammers which shear and knead the soil and sheepsfoot rollers, either towed or backhoe mounted static types or self-propelled static or vibratory, which shear, blend and bond the soil. These recommendations also indicate that the thickness of the soil layer being compacted should not exceed the capabilities of the compacting force of the equipment being used. Proper thickness allows full and uniform densification of each layer and is directly proportional to the number of passes required to achieve the desired result. Steel wheeled smooth rollers, either static or vibratory or vibratory smooth plates are not normally recommended for use on cohesive soils but are highly recommended for consolidating granular soils. When compacting a mixture of cohesive and granular soils, equipment designed for the predominant soil type should be used.
- c. Basis for Acceptance of Compaction: Normally the nuclear densimeter test shall be the basis for acceptance of compacted backfill. However, when backfill materials consist of a mixture of different soil types or contain a substantial amount of rock chips, the nuclear densimeter may give erroneous results. Therefore, the test results may be tempered by the judgment of the Engineer's representative after observing the compaction effort. The decision to accept or reject compacted backfill may be influenced by the thickness of lift, type of compaction equipment, number of passes of compaction equipment, depth of penetration of steel probe into the compacted material or successful proof rolling with a fully loaded tandem axle dump truck.
- d. Backfill Around Structures: Backfill around structures with approved material after completion of below grade construction and removal and cleanup of all forms, lumber and trash. Each layer shall be placed and compacted as specified for Type A compaction and shall include emphasis on the area adjacent to the structure walls.
- e. Trench Backfill: Backfill trenches only after pipelines, joints, wyes and bedding have been inspected and approved. Backfill with approved material from excavation or supplementary borrow areas, free from rocks or clods larger than 3 inches in any dimension.

- 1) Initial Backfill for Pipes with Pipe Stiffness (PS) of 100 or less. This category includes PVC pipe meeting the requirements of ASTM D 3034 SDR 35 and ASTM F 679 PS 46. Initial backfill shall consist of specified bedding material to a point 6 inches above the top of the pipe. Care shall be taken to insure that bedding material is worked in around the haunches of the pipe. Bedding material shall be compacted as specified for Type A compaction.
- 2) Initial Backfill for Pipes with Pipe Stiffness (PS) over 100. This category includes PVC pipe meeting the requirements of ASTM D 2665 (Schedule 40), ductile iron pipe, vitrified clay pipe, reinforced concrete pipe and corrugated steel pipe. For pipe up to and including 12 inches in diameter, the initial backfill shall consist of specified bedding material to the top of the pipe. For pipe over 12 inches in diameter, initial backfill shall consist of specified bedding material to the springline of the pipe. Care shall be taken to insure that bedding material is worked in around the haunches of the pipe. Bedding material shall be compacted as specified for Type A compaction.
- 3) Backfill from Springline to One Foot Over Top of Pipe: This applies to all types of pipe regardless of where the top of bedding material is located. Selected backfill material shall be placed on both sides of the pipe equally to the full width of the trench in loose layers not to exceed 6 inches thick. Each layer shall be compacted as specified for Type A compaction. Continue to place and compact subsequent layers until the pipe is covered to a depth of at least one foot. All material to this depth shall be compacted as specified for Type A compaction.
- 4) Backfill for the Remainder of the Trench: After selected backfill and compaction to 1 foot above the top of pipe, the remaining backfill shall be composed of selected excavated materials free from large clods, rocks, frozen materials, debris or junk or of approved supplementary borrow material. Backfill material shall be deposited and compacted as detailed for the required type of compaction.

3. Compaction

- a. Type A Compaction: Type A compaction shall be used under all paved areas proposed or future paved areas, except sidewalks and under utility tunnel crossings. Type A compaction shall also be used where sewers intersect stream beds and at other locations designated on the Project Drawings, around structures, and to a level not less than 1 foot above the top of sewer pipes, as specified elsewhere in this section. Backfill shall be composed of selected excavated material or approved supplementary borrow material. Backfill material shall be deposited in loose layers not more than 6 inches thick, and compacted to at least 95 percent of maximum density in accordance with AASHTO T 99 (Standard Proctor).
 - b. Type B Compaction: In areas where Type A compaction is not specified, approved backfill material shall be placed in the trench in loose layers not more than 10 inches thick and compacted to a density equal to or greater than that of the material in the adjacent trench wall.
4. Unsuitable Backfill Material: No material shall be used for structure backfill or trench backfill which contains rocks or clods larger than 3 inches in any dimension, frozen material, debris, junk or organic material. Such material shall be removed from the backfill material and disposed of as directed by the Engineer. Removal and disposal of unsuitable material is subsidiary to other bid items.
 5. Supplementary Borrow Material: Furnished by Contractor at his expense.
 6. Blasting: Prohibited.

7. Clean-Up: Clean-up is considered an integral part of the work. The working area shall be promptly restored to a condition equal to or better than that prevailing before construction. The Engineer may, at his discretion, withhold payment for otherwise completed items of work in areas in which clean-up is not completed, unless the Contractor submits, in writing, acceptable reasons why clean-up is incomplete, and provides an acceptable schedule for completion.

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 design considerations into account. 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. Clear interior of piping and manholes of dirt and superfluous material as work progresses.
- F. Familiarization: Prior to all work of this section, become thoroughly familiar with the site, the site conditions and all portions of the work falling within this section. No extra will be allowed for rock excavation.
- G. Install gravity-flow piping and connect to building's storm drains, of sizes and in locations indicated. Terminate piping as indicated.
 1. Install piping pitched down in direction of flow, as indicated on the plans.
- H. Removal of Water
 1. Furnish and operate sufficient pumps and appliances and provide all materials, labor, etc., required to prevent interference with any work by water, ice or snow. Damage of any kind resulting from insufficient pumping facilities or similar lack of proper conduct of the work shall be made good by the Contractor at his own expense.
 2. No structure or pipe shall be laid in water and no water shall be allowed to run into or over any concrete work or pipe, or into or through any pipe, unless by special permission in writing.
- I. Pipe Handling & Cutting
 1. Care shall be used in handling all pipe to prevent damage to pipe ends. Particular care shall be taken not to injure any pipe coatings. No other pipe or material of any kind shall be placed inside of any pipe or fitting, except as specifically indicated.
 - a. Damaged pipe or pipe damaged in laying shall be replaced at the expense of the Contractor.
 - b. Cutting shall be done in neat and workmanlike manner by a method which will not damage the pipe. All cutting shall be done by means of a mechanical cutter.

- J. Provide the necessary mason's lines and supports or laser equipment to insure installation of the pipe to line and grade, as shown on the drawings. Facilities for lowering the pipe into the trench shall be such that neither the pipe nor the trench will be damaged or disturbed.
- K. The Engineer may, at his option, inspect all pipe before it is laid and reject any section that is damaged by handling or is found to be defective to a degree which will materially affect the function and service of the pipe.
- L. The laying of the pipe in the finished trench shall be started at the lowest point and laid upgrade. When bell and spigot pipe is used, the bell shall be laid upgrade, with the spigots that fit within the bells laid in the direction of flow. If tongue and groove pipe is used, the groove shall be laid upgrade, with the tongue that fits inside the groove laid in the direction of flow. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line, and pull past each joint as it is completed.
- M. The pipe shall be firmly and accurately set to the line and grade so that the invert will be smooth and uniform in slope.
- N. Granular Bedding: Pipe shall be laid in compacted granular bedding as shown and as indicated in the plans or specified herein.
 - 1. Granular Bedding: Clean, well-graded crushed stone, chat, sand or gravel. Maximum particle size of one inch (1") diameter.
 - 2. Granular bedding shall be placed and compacted simultaneously on each side of pipe using particular care to obtain uniform bedding throughout the length of pipe without causing displacement of or damage to joints.
 - 3. When bell and spigot pipes are used, spaces for the pipe bells shall be dug in the pipe bedding to accommodate the bells. These spaces shall be deep enough to insure that the bells do not bear the load of the pipe; they shall not be excessively wide in relation to longitudinal direction of the trench. When the pipes are laid, the barrel of each section of pipe shall be in contact with the bedding throughout its full length, exclusive of the bell, to support the entire load of the pipe.
 - 4. Pipe shall not be laid on frozen ground under embedment.
- O. Pipe which is not true in alignment or which has shown any settlement after laying shall be taken up and re-laid without extra compensation

3.3 PIPE JOINT CONSTRUCTION

- A. Where specific joint construction is not indicated, follow piping manufacturer's written instructions.
- B. Join gravity-flow, non-pressure drainage piping according to the following:
 - 1. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-gasket joints.
 - 2. Join dissimilar pipe materials with non-pressure-type flexible couplings.
- C. PVC Sewer Pipe and Fittings: As follows:
 - 1. Join pipe and gasketed fittings with gaskets according to ASTM D 2321.
 - 2. Install according to ASTM D 2321.

- D. Concrete Pipe and Fittings: Install according to ACPA's "Concrete Pipe Installation Manual." Use the following seals:
 - 1. Round Pipe and Fittings: ASTM C 443, rubber gaskets.
 - 2. All joints shall be sealed with an approved plastic compound. In sealing pipe joints with plastic joint compound, trowel grade compound shall be applied to the mating surfaces of both the tongue and groove, or to the entire interior surface of the bell and the upper portion of the spigot. Rope or tape type and trowel grade plastic compound shall be applied in accordance with the manufacturer's recommendations. The joints shall be forced together with excess compound extruding both inside and outside the joint. Excess compound shall be removed from the interior surface where accessible.
- E. System Piping Joints: Make joints using system manufacturer's couplings, unless otherwise indicated.
- F. Join piping made of different materials or dimensions with couplings made for this application. Use couplings that are compatible with and that fit both systems' materials and dimensions.
- G. Connection to Existing Drainage Structures
 - 1. Where the drawings call for connections to existing or extension of structures, these connections shall be watertight and so made that a smooth uniform flowline will be obtained throughout the drainage system. Method to be approved.

3.4 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 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 medium-duty, top-loading classification cleanouts in paved foot-traffic areas.
 - 3. Use heavy-duty, top-loading classification cleanouts in vehicle-traffic service areas.
 - 4. Use extra-heavy-duty, top-loading classification cleanouts in roads.
- B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 24 by 24 by 7-1/2 inches deep. Set with tops 1 inch above surrounding grade.
- C. Set cleanout frames and covers in concrete pavement with tops flush with pavement surface.

3.5 MANHOLE INSTALLATION

- A. General: Install manholes, complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections with sealants according to ASTM C 891.
- C. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 1 inch above finished surface elsewhere, unless otherwise indicated.

3.6 STORM DRAINAGE INLET AND OUTLET INSTALLATION

- A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.

- B. Construct riprap of broken stone, as indicated.
- C. Install outlets that spill onto grade, anchored with concrete, where indicated.
- D. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.
- E. Construct energy dissipaters at outlets, as indicated.

3.7 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318 and ACI 350R.

3.8 INLET INSTALLATION

- A. Set frames and grates to elevations indicated.

3.9 CONNECTIONS

- A. Connect non-pressure, gravity-flow drainage piping to building's storm building drains specified in Division 33 Section "Storm Utility Drainage Piping."
- B. 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.

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. 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. Air Tests: Test storm drainage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
 - a. Option: Test plastic gravity sewer piping according to ASTM F 1417.
- 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.
- E. Regulatory Requirements: Comply with requirements of applicable codes, regulations and authorities having jurisdiction.
- F. Maintenance
1. If at any time before 12 months after the completion and acceptance of the work, there shall be any settlement of trenches requiring repairs to be made in any roadway, parking area or property along the line of the work, or should any defect appear in the work due to neglect, carelessness or improper construction on the part of the Contractor, the Engineer will notify the Contractor to make such repairs and remedy any defects. The Contractor shall, within 5 days after such notice, begin and carry out such repairs at no additional cost to the Owner.

END OF SECTION 33 4100