US Army Corps
of Engineers
Baltimore District

CONSTRUCTION SPECIFICATIONS

RENOVATION OF THE FREMONT BUILDING, PHASE 2

NIMA, BETHESDA, MARYLAND

INVITATION FOR BIDS **DACA31-03-B-0004**

CONTRACT NO.

DATE **AUG 06, 2003**

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SECTION 01001(Abr) - SPECIAL PROVISIONS

PART 1 - GENERAL

1.1. STATEMENT OF WORK: The work shall consist of the Contractor furnishing all plant, labor, materials and equipment and performing the work in strict accordance with the drawings and specifications within the time allotted for the following project:

FREMONT BUILDING RENOVATION – PHASE II
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A. Base Bid Item: All work required to renovate the first, second and third floors and re-roof the building.

B. Option 1 Bid Item: All work required to construct the pedestrian bridge.

C. Separation of Base Bid and Option: All work shown on the drawings, exclusive of the work covered under the Optional Bid Items shown below. The following as shown on the drawings <u>are not</u> to be included in the Base Bid, but <u>shall be</u> included in the Option.

1. All work shown on drawings C-1, C-2, C-3, C-4, C-5 and C-6.
2. Demolition shown on drawing A-4 keyed Note 12.
3. New work shown on drawing A-8 on column line E, from lines 12 to 13; Elevation - Doors 3E, Detail "A", Section "A-A" and Section "B-B"; Security Lobby Counter.
4. All work shown on drawing A-14.
5. All work shown on drawings S-1, S-2 and S-3.
6. All work shown on drawing M-11 associated with providing HWR/B in the Security Lobby.
7. All work shown on drawing E-15, Bridge Lighting – New work; and on the third floor plan fixtures E and H adjacent to column 12/E.
8. All work shown on drawing E-16, Bridge Power, New Work.
9. All work shown on drawing E-17, Part Third Floor Plan, Power- New Work associated with the Security Work Station, X-ray and turnstiles.
10. All work shown on drawing E-21.
11. All work shown on drawing E-39, Panel "CL3-C7" associated with circuits #6 through #20 inclusive.

1.2. PERFORMANCE TIME: three hundred thirty five (335) calendar days. "Days" hereafter referred to in the specifications are calendar days.

1.3. WORK HOURS/LIMITED HOURS/QUIET HOURS: The Contractor shall perform the work during an 8 ½ hour daily period (unless indicated otherwise below) established elsewhere in this contract, or by the Contracting Officer's Representative (COR), Monday through Friday, excluding Federal holidays and as indicated below.

A. Regular Hours: 0630 – 1700 (6:30 AM – 5:00 PM)

B. Outside Regular Hours: Requires 5 day advance written notice and approval by the COR. Contract work performed outside of regular hours shall be at no additional cost to the Government.

C. Quiet Hours: Work shall be limited/suspended and/or not performed as indicated below:

1. Tours and Ceremonies – all facilities: no loud or excessive noise during tour/ceremony. The COR will normally provide 24 hour notice of scheduled events. Delays of up to 4 hours shall be a no additional cost to the Government.

1.3.1. SPECIAL PROJECT REQUIREMENTS: *[not applicable to this contract]*

1-4. IDENTIFICATION OF EMPLOYEES: Each contractor and subcontractor employee to include delivery personnel requiring entry into NIMA facilities shall obtain, display and surrender upon leaving the site a NIMA access badge. Seven (7) days prior to the start of construction, the Contractor shall submit a roster of personnel on company letterhead and signed by the project manager to the COR for the purpose of obtaining badges. The roster shall contain the following information for EACH employee:

a. Name (last, first, middle initial)
b. Social Security Number
c. Complete home address and telephone number
d. Citizenship – U.S. CITIZENSHIP REQUIRED – NO FOREIGN NATIONALS PERMITTED

1.5. FACILITY: This contract includes interior and exterior work at the following site/facility(ies):

Dalecarlia Site: Fremont Bldg

A. Occupancy: The facility will be occupied during construction.

B. Security/Access: The facility does contain Secure Compartmented Information Facility (SCIF) areas within the limits of work which require special escort arrangements and may cause some delays in gaining access. Delays up to 45 minutes and any delays due to Contractor non-conformance with security procedures are at no additional cost to the Government. Contractor access to SCIF areas requires five (5) working day advance notice to the COR.

C. Maintenance of Access: The Contractor shall, at all times, maintain clear and safe passage into and throughout the facility. No long-term (more than 48 hours) storage within the facility is permitted. All debris shall be removed daily.

D. Protection: The Contractor shall protect Government property in accordance with the clause of this contract entitled *Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements,* and as follows:

1. All existing Government property shall be protected from construction operations. As a minimum, the Contractor shall cover and protect all furniture, equipment, carpet and other Government property in the work area.

2. The Contractor shall provide dust barriers to seal the work area to prevent migration of dust and construction debris into adjoining spaces.

3. The Contractor shall protect occupants of the facility in accordance with the clause of this contract entitled *Accident Prevention* and the approved Accident Prevention Plan.

4. The Contractor shall take such additional measures as may be directed by the COR or NIMA Safety personnel to prevent damage or injury to Government property or personnel.

E. Fire Safety: The Contractor shall protect property and occupants of the facility in accordance with the clause of this contract entitled *Accident Prevention* and the approved Accident Prevention Plan and the following:

1. The Contractor shall notify the COR five (5) days in advance of any welding, cutting or use of any open-flame equipment and request a flame permit. The Contractor shall take necessary fire prevention precautions in accordance with NFPA 51B prior to the NIMA safety inspection of the work area and issuance of a flame permit. The Contractor shall protect against false alarms, accidental discharge and damage to fire detection/suppression equipment.

2. When modifying or otherwise affecting any NIMA fire protection/suppression system, the Contractor shall be responsible for maintaining all ratings in accordance with all current NFPA 13 requirements.

G. Asbestos Containing Material (ACM): ACM does not exist in the facility. If non-designated ACM or suspected ACM is encountered, the Contractor shall not disturb the material and notify the COR immediately. All ACM shall be removed by the Government. The Contractor shall allow for interruption of work for the removal of previously unknown ACM in the work area in accordance with the clause of this contract entitled *Other Contracts*.

H. Smoking: The Contractor shall comply with the NIMA policy that smoking is permitted in designated areas only. This applies to Contractor's employees and visitors on a 24 hour a day basis. Smoking is prohibited inside all facilities.

1.6 SITE RESTRICTIONS: All NIMA sites are considered to be restricted areas. The Contractor shall be responsible for compliance with all installation regulations.

A. Site Access: All Contractor personnel entering NIMA sites shall present a valid picture I.D. before receiving a NIMA Contractor's badge.

B. Contractor Parking: All Contractor and Subcontractor personnel shall register their vehicles with the Security Police when obtaining daily access. All Contractor personnel shall conform to NIMA parking regulations. Parking on site is not guaranteed to be available.

C. Haul Routes: Haul routes shall be as shown on the drawings or as otherwise designated by the COR.

D. Staging/Storage/Dumpster Areas: Contractor staging/storage areas shall be in accordance with the clauses of this contract entitled *Operations and Storage Areas* and *Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements* and the following:

1. Arrangements for staging/storage/dumpster areas must be coordinated with and approved by the COR at the pre-construction conference.

2. The Contractor is not guaranteed exclusive use of staging/storage/dumpster areas and shall relocate to another area at no cost to the Government if the Government has need of the areas.

3. No flammable or hazardous materials may be stored on the site.

4. All construction debris shall be disposed of daily off site in accordance with all current Federal, State and local statutes regarding hauling and disposal. Burning is not permitted.

5. All deliveries which will disturb normal site operations (street closures, parking, pedestrian routes, etc.) shall be coordinated with the COR five (5) days in advance. All deliveries to the Erskine Hall loading dock shall be in accordance with paragraph 1.3.D. above.

6. The Contractor may use existing freight elevators but is not guaranteed exclusive use. The Contractor shall have an alternate plan of moving materials if elevators are unavailable. Alternate methods shall be at no additional cost to the Government.

7. Temporary office and storage facilities and all temporary utility services shall be at the Contractor's expense and installed in accordance with applicable building codes.

E. Street Closures: Required street closures shall be coordinated with the COR ten (10) days in advance. The Contractor shall provide all signs, barricades, markers, etc. required by the COR and the Safety Office for traffic guides and public safety.

1.7 USE OF UTILITIES: Facility/Site utilities are available for Contractor's use in accordance with the clause of this contract entitled *Availability and Use of Utility Services*. Any temporary services shall be in accordance with all applicable codes and *Corps of Engineers Engineering Manual EM 385-1-1* latest edition.

1.8. UTILITY OUTAGES: No utility services shall be interrupted by the Contractor without prior approval of the COR. The Contractor shall request outages not less than forty-five (45) days in advance of required date. All curtailments will be performed by Government personnel. The Government reserves the right to cancel approved outages at any time up to 4 hours prior to scheduled start time. Outage requests shall contain he following information:

a. Type of utility (electric, gas, water, etc.)
b. Size of line and location of shutoff.
c. Hours and dates of curtailment.
d. Estimated length of curtailment time.
e. Facilities and services affected.
f. Outage level definition as advised by the COR.

A. Utility Outage Level Definitions: Coordinate with the COR to determine appropriate outage level prior to submitting request.

1. Level 1: Utility outage that affects an entire site or facility that interrupts Government operations or affects mission critical activities or a NIMA-wide system. Must be accomplished on weekends and/or Federal holidays. A weekend is defined as beginning at 1800 (6:00 PM) on the last working weekday of the week and ending at 0530 (5:30 AM) on the first working weekday of the new week.

2. Level 2: Utility outage that affects part of a site or facility that interrupts Government operations or affects mission critical activities. Must be accomplished on weekends and/or Federal holidays as defined above.

3. Level 3: Utility outage that affects part or all of a site or facility that does not interrupt or constitute a risk of interrupting Government operations or mission critical activities.

B. Fire Mains: When water supplies to fire mains are interrupted, the Contractor shall arrange his operation to complete the work without undue delay and to restore service immediately in the event of an emergency. All service shall be made active at the end of the workday.

C. Gas Mains: Flow in gas mains which have been curtailed shall not be restored until the COR has verified that all items serviced by that main have been shut off.

1.9 SCHEDULING: The Contractor shall schedule the work in accordance with the clause of this contract entitled *Schedules for Construction Contracts*, specifications section *Submittals*, and the following:

A. Schedule Type: Critical Path Method (CPM) Chart: See specification section *CPM Schedules*.

B. Phasing Requirements: Work phasing will not be required.

1.10 WEATHER DATA: Data and information furnished or referred to below is for the Contractor's information. The Government shall not be responsible for any interpretation of or conclusion drawn from the data or information by the Contractor. The following monthly precipitation day data is based upon National Oceanographic and Atmospheric Agency (NOAA) or similar data for the geographic location of the project and shall serve as the baseline for monthly (or portion thereof) weather time evaluations. The Contractor shall maintain a log of actual weather conditions on his daily report.

MONTH/NUMBER OF PRECIPITATION DAYS

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
5	6	7	8	7	7	7	6	3	6	5	4

1.11 PRE-CONSTRUCTION CONFERENCE: The Contractor shall not proceed with work on site until the pre-construction conference has been held. Subsequent progress or coordination meetings may be held during the course of the contract when determined to be necessary.

1.12 CONTRACT DOCUMENTS: Upon award, the Contractor shall be given no more than six (6) sets of hard copy contract documents. Additional sets may be provided by the Government, upon request, at the cost of reproduction, such costs to be deducted from the contract amount or the Contractor may purchase additional sets directly from the printer. The Contractor shall be responsible to supply and distribute documents to subcontractors.

1.13 OTHER CONTRACTS: The Government has awarded separate contracts for performance of certain work at the project site as indicated below:

A. Communications cabling, systems, and related infrastructure.
B. Furniture, fixtures, and equipment.
C. Security Management System including related devices and wiring.
D. Asbestos Abatement.

1.14 USE AND POSSESSION: In accordance with the clause of this contract entitled *Use and Possession Prior to Completion*, the Government shall have the right to take possession of or use any completed or partially completed part of the work.

1.15 GENERAL TECHNICAL REQUIREMENTS: See specification section *General Technical Requirements.*

1.16 SUBMITTALS – ADMINISTRATIVE AND TECHNICAL: See specification section *Submittals*.

1.17 QUALITY CONTROL: See specification section *Contractor Quality Control*.

1.18 ENVIRONMENTAL REQUIREMENTS: See specification section *Environmental Protection.*

1.19 APPLICABILITY: THIS SECTION APPLIES TO ALL WORK UNDER THIS CONTRACT.

PART 2 - PRODUCTS --- NOT USED
PART 3 - EXECUTION --- NOT USED
END OF SECTION

SECTION 01002(Abr) – GENERAL TECHNICAL REQUIREMENTS

PART 1 – GENERAL

1.1 PURPOSE OF SECTION: This section contains general technical requirements including but not necessarily limited to references, regulations, procedures, codes, materials, industry standards and installation data applicable to all technical sections of these specifications.

1.2 GENERAL WORK REQUIREMENTS: In accordance with the clause of this contract entitled *Specifications and Drawings for Construction*, the Contractor shall provide all labor, materials, equipment and services required to achieve a complete and usable end product as shown on the drawings or specified herein or both, to include any and all minor incidental items normally required and customarily performed as part of the work even though not specifically shown or specified in the contract documents.

1.3 RELATED WORK: All technical sections of these specifications and the graphic intent thereof as indicated on the drawings are considered to be related work. Omissions from the drawings or specifications or the misdescription of details of work which are manifestly necessary to carry out the intent of the drawings and specifications and/or which are customarily performed for a "complete in place" end product, shall not relieve the Contractor from performing such omitted or misdirected details of the work, but shall be performed as if fully and correctly set forth and described in the drawings and specifications.

1.4 EXISTING CONDITIONS: In accordance with the clauses of this contract entitled *Differing Site Conditions, Site Investigation and Conditions Affecting the Work, and Physical Data,* the Contractor shall carefully examine all existing site conditions. If any discrepancies are observed between the contract documents and the existing conditions, the Contractor shall immediately notify the Contracting Officer or the Contracting Officer's Representative (COR) in writing.

1.5 COORDINATION OF THE WORK: The Contractor shall comply with the requirements of the clauses of this contract entitled *Superintendence by the Contractor, Permits and Responsibilities, Schedules for Construction Contracts, Organization and Direction of the Work, Specifications and Drawings for Construction,* and the following:

A. Supervision: The Contractor shall provide the name, qualifications (in resume format), duties, responsibilities, and authorities of the assigned supervisory staff which includes as a minimum:

1. Project Manager: The Project Manager shall be responsible for the overall management of the project including quality and production but may not serve as the Contractor's Quality Control Manager (CQM) described in specification section *Contractor Quality Control*. The Project Manager shall have a minimum of five (5) years' experience in construction and project management roles.

2. Site Superintendent: The site superintendent shall be responsible for field supervision and coordination on a full time basis and shall not function as part of the construction work force. If multiple work sites are involved, the Contractor shall provide a qualified prime contractor superintendent for each site.

3. Quality Control Staff: See specification section *Contractor Quality Control*.

B. LEGAL REQUIREMENTS: In accordance with the clause of this contract entitled *Permits and Responsibilities*, the Contractor shall comply with all legal requirements which are applicable to the work under this contract. In case of conflict, the most stringent requirement applies.

C. DRAWINGS AND SPECIFICATIONS: The Contractor shall comply with the requirements of the clause of this contract entitled *Specifications and Drawings for Construction,* and the following:

1. Drawings: The drawings provide a graphic interpretation of the project intent and the information shown is normally diagrammatic in character and does not indicate every item and/or component required for a complete and usable installation. Do not scale drawings. Use printed dimensions or the graphic scales provided therein.

2. Specifications: The specifications define the quality of the materials to be used and the quality of the workmanship required to install those materials to achieve the desired project intent. Deviations/ variations from the specifications must be requested under specifications section *Submittals*.

3. Discrepancies: In general, the specifications overrule the drawings. For drawing discrepancies the order of precedence is 1-Notes, 2-Large scale drawings and 3-Small scale drawings.

4. Abbreviated Language: Abbreviations are used extensively on the drawings. Refer to applicable legends for meaning. In the specifications, the omission of some phrases such as “the Contractor shall”, “in accordance with”, “shall be”, as noted on the drawings”, “a”, “the”, are intentional. Supply omitted words or phrases by inference in the same manner as when “NOTE” occurs on drawings. Supply words “shall be” or “shall” by inference when a colon is used is used with sentences or phrases. Supply words “on the drawings” by inference when “as indicated” is used with sentences or phrases.

D. INDUSTRY STANDARDS: Unless the contract documents include more stringent requirements, applicable construction industry standards shall have the same force and effect as if bound or copied directly into the contract documents to the extent referenced. Such standards are made a part of the contract documents by reference.

PART 2 – PRODUCTS

2.1 PRODUCTS: “Products” are items purchased for incorporation into the work, whether purchased specifically for this contract or taken from previously purchased stock. The term “product” includes the terms “material”, “equipment”, “system”, and terms of similar intent. The Contractor shall comply with the clause of this contract entitled *Material and Workmanship* and the following:

A. Acceptable Manufacturers: Some sections of the specifications may list “acceptable Manufacturers”. This indicates that the Government considers the products of these manufacturers to be equal.

B. Design Basis: Some sections of the specifications may list a particular brand name, manufacturer, model number, etc. as the "Design Basis". This is normally done when the Government desires a specific aesthetic effect, configuration, level of performance or compatibility with existing conditions, materials or equipment.

C. Product Sources: The Contractor shall comply with the requirements of the Buy American Act as incorporated into these specifications by reference to the maximum extent possible. Use of foreign made products shall be only with the written approval of the Contracting Officer or COR.

D. Product Uniformity: Where two or more items of the same class are required, the Contractor shall provide products of a single manufacturer to the maximum extent possible. Component parts of equipment need not be products of the original equipment manufacturer.

E. Product Identification: Each product shall bear a nameplate or other permanent method of identification affixed in a conspicuous place containing the manufacturer's name, address, model number and serial number. Distributor's nameplates are not acceptable. When other stamps or labels are required by these specifications, they shall be provided on each product or piece of equipment.

F. Ancillary Items: Miscellaneous items such as trim pieces, valves, gauges, switches, installation and adjusting tools, etc., normally considered as standard parts of assemblies, equipment or product packages, shall conform to the original manufacturer's standard and shall be provided by the Contractor whether or not specifically indicated or specified.

2.2 SUBSTITUTIONS: Specified products indicate the minimum acceptable level of quality/ performance. The products of any manufacturer may be substituted on an "or approved equal" basis provided that the item is a product of a manufacturer regularly engaged in the production of such materials/equipment; represents the manufacturer's latest design; has been in satisfactory commercial or industrial use at least 2 years; and sufficient documentation is provided to indicate the proposed product meets or exceeds the specification. Substitution does not relieve the Contractor from meeting the terms and conditions of the contract. Procedures for product substitutions are given in specification section *Submittals*.

2.3 REQUIRED GOVERNMENT SALVAGE: Whether indicated or not on the drawings or elsewhere in the specifications, the following items shall always be carefully removed and turned over to the COR as required Government salvage:

A. Lock cylinders and cores
B. Card readers
C. Security hardware
D. Combination and cypher locks

PART 3 – EXECUTION

3.1 GENERAL: All work under this contract shall be in strict accordance with the drawings, specifications and other contract requirements incorporated by reference. When work shall be in accordance with manufacturer's recommendations/instructions, the Contractor shall have the manufacturer or an approved representative provide services and supervision to insure compliance.

3.2 LAYOUT AND COORDINATION OF THE WORK: In accordance with the clauses of this contract entitled *Superintendence by the Contractor, Permits and Responsibilities, Schedules for Construction Contracts, Layout of Work, and Organization and Direction of the Work*, the Contractor shall lay out, schedule, coordinate and supervise the work of all trades including subcontractors and delivery personnel to achieve an orderly progress of installation resulting in a complete and usable end product within the contracted performance time and dollar amount.

3.3 DELIVERY, STORAGE AND HANDLING: It shall be the responsibility of the Contractor for the timely delivery, careful handling and protection from damage or theft of all materials and equipment associated with the work, to include any Government furnished items once received by the Contractor. Delivery, storage and handling requirements for specific items are indicated in the related specifications section. If the Government is required to provide storage and handling of contractor materials, the associated costs shall be deducted from the contract amount.

3.4 PROTECTION OF EXISTING WORK: It shall be the responsibility of the Contractor to protect buildings, grounds, equipment, materials, surfaces, etc., adjacent to but not included in the work from any damage which may result from the work or from adverse weather conditions. Similarly, the Contractor shall protect installed work of previous trades from damage which may be caused by work of subsequent trades. Damage caused by the Contractor's failure to protect existing work shall be repaired/replaced at no additional cost to the Government.

3.5 CUTTING AND PATCHING: This paragraph pertains to all cutting, removing, replacing, patching, repairing, restoration, refinishing, and similar type work as necessary to existing work scheduled to remain, and to new work required to be cut or uncovered.

A. Structural: Do not cut and patch structural elements in a manner that would change their load-carrying capacity or load-deflection ratio. Obtain COR approval before cutting and patching structural elements.

B. Operations: Do not cut and patch operating elements or related components in a manner that would result in reducing their capacity to perform as intended or would result in increased maintenance or decreased operational life or safety. Obtain COR approval before cutting and patching operating elements or safety related systems.

C. Aesthetics: Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would reduce the building's aesthetic qualities or that would result in visual evidence of cutting and patching.

D. Warranties: Replace, patch, and repair cut or damaged materials and/or surfaces by methods and with materials in a manner so as not to void any required or existing warranties.

E. Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible if identical materials are unavailable or cannot be used. Use materials whose installed performance will equal or exceed that of existing materials. All excess materials resulting from cutting and patching work shall be removed from the site.

F. Inspection: Prior to cutting, examine surfaces to be cut and patched, and conditions under which cutting and patching is to be performed. If unsafe or unsatisfactory conditions are anticipated or encountered, notify the COR before proceeding.

G. Preparation: Provide temporary support of work to be cut. Protect existing construction during cutting and patching to prevent damage. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas. Avoid cutting pipes, conduit, or ductwork serving the building or space but scheduled to be removed or relocated until provisions have been made to bypass them.

H. Performance: Employ skilled workmen to perform cutting and patching. Proceed with the work at the earliest feasible time and complete without delay. Cut existing construction using methods least likely to damage elements retained or adjoining construction. Patch with durable seams that are as invisible as possible. Comply with specified tolerances. For plaster installation, comply with manufacturer's instructions and install thickness and number of coats as indicated.

I. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove excess paint, mortar, oils, putty, and similar items. Thoroughly clean piping, conduit, and similar features before finishing. Restore damaged pipe covering to its original condition.

3.6 INSTALLATION: The final installation of materials or equipment shall be based on actual field dimensions and conditions and not on any schematic drawings. Provide all necessary items for a complete and usable installation. Perform all work in accordance with good commercial practice. Insure materials or equipment are installed plumb, level and square and finished properly. Good appearance of finished work is of equal importance with its performance. Protect installed work from damage. Provide all access panels, labels, markings, clearances, etc. required by code and the specifications.

3.7 FIELD ADJUSTMENTS: When substitute products are approved for use, the Contractor, at no additional cost to the Government, shall be responsible for the field adjustment of space requirements, configurations, performance, changes in supports, structural members and openings, etc., and the work of other affected trades, to incorporate the substitute product. The Contractor shall notify the COR in writing of additional work required due to unforeseen and/or differing site conditions in accordance with the clause of this contract entitled *Differing Site Conditions*.

3.8 FINAL CLEANING/COMMISSIONING: The Contractor shall perform final cleaning in accordance with the clause of this contract entitled *Cleaning Up.* Installed materials and equipment shall be cleaned in accordance with the applicable specifications section. In addition, the work site shall be cleaned of all construction debris to include dust, dirt, grease, fingerprints, etc. from all exposed surfaces. Particular attention shall be made to removing dust, dirt, etc. from thermostats, fire alarm devices, switches, other control components and

from open piping systems such as condensate pans and drain lines. HVAC equipment shall be provided with new filter elements and be fully charged with appropriate rust inhibitive/anti-freeze chemicals as recommended by the equipment manufacturer. All building systems shall be fully operational. Dirt, bugs, etc. shall be cleaned from light fixtures and all burned out bulbs shall be replaced. Damage to adjacent existing buildings, grounds, surfaces, etc. not included in the work shall have been repaired/replaced and finished to match the existing. All Contractor equipment (trailers, portable latrines, temporary utilities, etc.) shall be removed from the work site and the area(s) restored to pre-construction condition. If building latrine facilities were utilized by Contractor personnel, their cleaning is considered part of the work as are Contractor haul routes and other Contractor access routes through spaces not included in the limits of work.

3.9 FINAL DOCUMENTATION: See specification sections *Contractor Quality Control* and *Submittals*.

END OF SECTION

SECTION 01003(Abr) – SUBMITTALS

PART 1 – GENERAL

1.1 SUMMARY: In accordance with the clauses of this contract entitled *Material and Workmanship, Inspection of Construction, and Specifications and Drawings for Construction*, specification section *Contractor Quality Control* and this section, the Contractor shall be responsible for the scheduling and control of all submittals.

1.2 SUBMITTAL CLASSIFICATION: Submittals are classified as follows:

A. Government Approval (GA): Government approval is required for all administrative submittals (see paragraph *Administrative Submittals* below) and for all extensions of the design, critical materials, deviations, equipment whose compatibility with the entire system must be checked, and other items so designated in the technical specifications. For the purposes of this contract, all submittals designated GA shall be considered "shop drawings" as described in the clause of this contract entitled *Specifications and Drawings for Construction.*

B. Information Only (IO): All submittals not requiring Government approval shall be for information only. They are not considered to be "shop drawings" within the terms of the FAR clause cited above.

1.3 APPROVING AUTHORITY: The approving authority for all submittals shall be the Chief, Construction Services of the NIMA Security and Installation Operations Directorate, Bethesda Facility (SIIBF). Submittals shall be reviewed for technical compliance by the Contracting Officer's Representative (COR), NIMA Project Manager and/or the Architect-Engineer (A-E) of record if Title II construction services are utilized.

1.4 ADMINISTRATIVE SUBMITTALS: At the pre-construction conference or within five (5) calendar days of the Notice To Proceed and prior to the start of construction, the Contractor shall submit for Government approval seven (7) copies of the following submittals. Construction will not be allowed to begin, nor payments made, until the following submittals have been approved. All administrative submittals shall be made in accordance with this specification section. Deviations from the submittal requirements will not be accepted.

A. Accident Prevention Plan (GA): In accordance with the clause of this contract entitled *Accident Prevention*, the Contractor shall develop and submit for Government approval a comprehensive Accident Prevention Plan addressing both general and contract specific accident prevention measures. NIMA is a Department of Defense (DoD) agency thus the provisions of the *U.S. Army Corps of Engineers Safety and Health Requirements Manual EM 385-1-1* (latest edition) shall apply.

B. Quality Control Plan (GA): In accordance with the clause of this contract entitled *Inspection of Construction* and specification section *Contractor Quality Control*, the Contractor shall develop and submit for Government approval a comprehensive Contractor Quality Control Plan addressing both general and contract specific quality control measures.

C. Environmental Protection Plan (GA): In accordance with the clauses of this contract entitled *Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements,* and *Permits and Responsibilities* and specifications section

Environmental Protection, the Contractor shall develop and submit for Government approval a comprehensive Environmental Protection Plan addressing both general and contract specific environmental protection measures.

D. Construction Schedule (GA): In accordance with the clause of this contract entitled *Schedules for Construction Contracts* and specification section *Special Provisions (*also section *CPM Schedules* when applicable), the Contractor shall develop and submit for Government approval a comprehensive and practicable schedule showing the manner of prosecution of the work. The Contractor shall submit schedule updates with each monthly payment application. Updates shall be added to the submittal register for tracking purposes.

E. Record of Existing Conditions (GA): In accordance with the clause of this contract entitled *Site Investigation and Conditions Affecting the Work* and specification section *General Technical Requirements*, the Contractor shall prepare and submit a Record of Existing Conditions for the entire project area and any other facilities impacted by the work. This record shall be documented by the Contractor in the presence of the COR. The record shall indicate the location and extent of existing damage and descriptions of existing surface conditions prior to the start of construction. If the Contractor elects to utilize photographs, they shall be numbered and incorporated into the submittal by providing written documentation describing each photograph as well as the location of each with respect to the contract documents.

F. Daily Report (GA): In accordance with the clause of this contract entitled *Inspection of Construction* and specification section *Contractor Quality Control*, the Contractor shall submit his proposed daily report form for approval. The content and subsequent daily submission of the daily report shall be in accordance with specification section *Contractor Quality Control*, paragraph *Interim Documentation*.

G. Submittal Register (GA): In accordance with the clause of this contract entitled *Material and Workmanship* and the requirements of this section *Submittals*, the Contractor shall review, annotate and submit Engineering Form (ENG) 4288 *Submittal Register* found at the end of this section. The submittal register shall be used by the Contractor for tracking all submittals required by the contract and shall be coordinated with the construction schedule. After the initial administrative submittal, the contractor shall submit updated registers every thirty (30) days thereafter.

1.5 TECHNICAL SUBMITTALS: Technical submittals required by the specifications are described in each individual specification section and listed on ENG 4288 at the end of this section. All submittals shall be in accordance with the requirements of this section.

1.6 APPROVED SUBMITTALS: In accordance with the clause of this contract entitled *Specifications and Drawings for Construction,* approval of GA designated submittals by the Government or no Government comment on IO designated submittals does not relieve the Contractor from responsibility for any errors or omissions in such submittals, nor from the responsibility to comply with the contract requirements with the exception of approved variations/deviations.

1.7 DISAPPROVED SUBMITTALS: The Contractor shall make all corrections required by the Government and provide a corrected resubmittal in the same form and number as the original. If the Contractor considers any correction constitutes a change in contract requirements, notice as required under the clause of this contract entitled *Changes* shall be promptly submitted to the COR.

1.8 USE OF UNAPPROVED MATERIALS: In accordance with the clauses of this contract entitled *Inspection of Construction, Material and Workmanship,* and *Specifications and Drawings for Construction*, unapproved materials and/or equipment incorporated into the work may be subsequently rejected and replaced by the Contractor with approved materials and/or equipment at no additional cost to the Government.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION

3.1 GENERAL: Required submittals shall conform to the following:

A. The Contractor shall submit all items listed on the submittal register ENG Form 4288 and/or specified in other sections of these specifications. The COR may request submittals in addition to those listed and/or specified when deemed necessary to adequately describe the work covered in the respective sections.

B. Units of weights and measures used on all submittals shall be the same used in the contract documents.

C. Submittals shall be made in the number of copies indicated on the submittal register. Each submittal shall be complete and in sufficient detail to allow ready determination of compliance with the contract requirements. Piece-meal submittals will be returned without action for resubmittal.

D. Prior to submission, all items shall be reviewed and approved by the Contractor's Quality Control (CQC) organization and each submittal shall be stamped, signed and dated by the Contractor's Quality Control Manager (QCM) certifying that the submittal complies with the contract requirements.

E. Shop drawings must be project specific. The reproduction of contract documents and/or details or manufacturer's standard drawings and/or details without specifically addressing project conditions is not considered to be a proper shop drawing. Shop drawings must clearly address how particular materials/equipment/procedures fit the project conditions.

3.2 SUBSTITUTIONS: Substitutions are defined as any changes, proposed by the Contractor after contract award, in materials, equipment or procedures required by the contract documents. Requests for substitutions, changes and/or deviations from the contract requirements shall conform to the following:

A. Proposed substitutions, changes and/or deviations from the contract documents shall be clearly identified on the transmittal form ENG Form 4025. The Government reserves the right to rescind inadvertent approval of submittals containing unnoted deviations. In addition, the submittal shall be accompanied by a separate letter from the Contractor giving a detailed description of the nature of the deviation, the reason(s) for the deviation, and the following information as appropriate:

1. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the

Government and separate contractors, that will be necessary to accommodate the proposed substitution.

2. A detailed comparison of significant qualities of the proposed substitution with those of the work specified. Significant qualities may include elements, such as performance, weight, size, durability, and visual effect.

3. Product Data, including Drawings and descriptions of products and fabrication and installation procedures.

4. Samples, where applicable or requested.

5. A statement indicating the substitution's effect on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.

6. Cost information, including a proposal of the net change, if any in the Contract Sum.

7. The Contractor's certification that the proposed substitution conforms to requirements in the Contract Documents in every respect and is appropriate for the applications indicated. When materials/equipment/procedures are submitted as an “equal” to a “Trade Name or approved equal” or a “Design Basis” trade name listed in the specifications, the submittal documentation must be in sufficient detail to clearly indicate the proposed item is, in fact, “equal” and not just “similar”.

8. The Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.

B. The request shall be submitted in the same number of copies as for a normal submittal. The Contracting Officer will consider requests for substitutions, changes, and/or deviations if received within 30 days after Notice to Proceed. Requests received more than 30 days after Notice to Proceed may be considered or rejected at the discretion of the Contracting Officer. In order to be considered by the Contracting Officer, the request must satisfy one or more of the following conditions:

1. Extensive revisions to the Contract Documents are not required.

2. Proposed changes are in keeping with the general intent of the Contract Documents.

3. The request is timely, fully documented, and properly submitted.

4. The specified product or method of construction cannot be provided within the Contract Time. The Contracting Officer will not consider the request if the product or method cannot be provided as a result of failure to pursue the Work promptly or coordinate activities properly.

5. The request is directly related to an "or-equal" clause or similar language in the Contract Documents.

6. The requested substitution offers the Government a substantial advantage, in cost, time, energy conservation, or other considerations, after deducting additional responsibilities the Government must assume. The Government's additional responsibilities may include compensation to the Architect/Engineer for redesign and evaluation services, increased cost of other construction by the Government, and similar considerations.

7. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.

8. The specified product or method of construction cannot be provided in a manner that is compatible with other materials and where the Contractor certifies that the substitution will overcome the incompatibility.

9. The specified product or method of construction cannot be coordinated with other materials and where the Contractor certifies that the proposed substitution can be coordinated.

10. The specified product or method of construction cannot provide a warranty required by the Contract Documents and where the Contractor certifies that the proposed substitution provides the required warranty.

11. Where a proposed substitution involves more than one prime contractor, each contractor shall cooperate with the other contractors involved to coordinate the Work, provide uniformity and consistency, and assure compatibility of products.

C. If necessary, the Contracting Officer will request additional information or documentation for evaluation within one week of receipt of a request for substitution. The Contracting Officer will notify the Contractor of acceptance or rejection of the substitution within 3 weeks of receipt of the request, or 2 weeks of receipt of additional information or documentation, whichever is later. Acceptance will be in the form of a Modification. If the Contracting Officer does not render a decision within the allotted time, use the product specified.

3.3 PROHIBITED SUBSTITUTIONS: Requests for substitutions, changes, and/or deviations will not be considered for the following:

None

3.4 SUBMITTAL REGISTER (ENG FORM 4288): At the end of this section is ENG Form 4288 Submittal Register which lists each item of equipment, material and/or procedures for which submittals are required by the specifications. It is the Contractor's responsibility to verify that the submittal register includes all submittals required by the contract documents. Submittals required by the specifications and/or submittals requested by the COR but not listed on the submittal register are considered required submittals and the Contractor shall annotate the register to include such submittals. Columns "a" through "e" have been completed by the Government. The Contractor shall complete columns "f" and "g" and submit the annotated register in accordance with this section *Submittals* paragraph *Administrative Submittals.* The approved submittal register shall become the scheduling document and shall be used to control submittals throughout the life of the contract. This

register and the construction progress schedule shall be coordinated. As submittals are processed, both the Government and the Contractor shall complete columns "h" through "n" on their respective copies. Column "o" is for Government use. Column "p" is common use.

3.5 TRANSMITTAL FORM (ENG FORM 4025): ENG Form 4025 shall be used for submitting Government Approval (GA) and Information Only (IO) submittals in accordance with the instructions accompanying the form. A copy of the form is included at the end of the submittal register. This form shall be properly completed by filling out all heading blank spaces and identifying each item submitted. Special care shall be exercised to ensure proper listing of the specification section, paragraph, and/or sheet number of the contract documents pertinent to the data submitted for each item. For submittals which include proposed deviations requested by the Contractor, column titled *Variation* shall be checked.

3.6 SCHEDULING AND PROCESSING: The Contractor shall carefully control his procurement operations to ensure that each individual submittal is made on or before the Contractor scheduled submittal date shown on the approved submittal register.

A. Scheduling: Submittals requiring Government approval (GA) shall be scheduled and made prior to acquisition of the material or equipment covered thereby. Submittals covering component items forming a system or items that are interrelated shall be scheduled to be coordinated and submitted concurrently. Certifications to be submitted with the pertinent drawings, data, etc. shall be so scheduled.

B. Processing: The Contractor shall allow sufficient time for Government submittal review, including potential resubmittal as follows:

1. Allow a minimum of seventeen (17) days for initial review. Additional time may be required if the COR must delay processing to permit coordination with subsequent submittals.

2. If an intermediate submittal is required, it will be processed the same as an initial submittal.

3. Allow seventeen (17) days for processing resubmittals.

4. No extension of contract time shall be authorized due to the Contractor's failure to transmit submittals to the COR for processing sufficiently in advance of the work.

3.7 GOVERNMENT APPROVED SUBMITTALS: The Government will indicate the submittal review action on the ENG Form 4025. Two (2) copies of approved submittals will be retained by the Government, the balance being returned to the Contractor. All copies of disapproved submittals will be returned to the Contractor for correction and resubmittal.

3.8 INFORMATION ONLY SUBMITTALS: Normally, Information Only submittals will not be returned to the Contractor. Government approval is not required and these submittals will be used for information purposes. This does not relieve the Contractor from the obligation to furnish materials conforming to the contract requirements and will not prevent the Government from requiring the removal and replacement of non-conforming materials incorporated into the work. This does not relieve the Contractor of the requirement to furnish samples for laboratory testing or check testing by the Government in those instances where the technical specifications so prescribe. The Government reserves the right to require the Contractor to resubmit IO submittals as GA submittals if the initial IO submittal is found not to comply with the contract requirements.

END OF SECTION

Fremont Building Renovation - Phase II NATIONAL IMAGERY & MAPPING AGENCY

SECTION 02070 SUBMITTAL REGISTER Page SR- of

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
02070	Dust Control Measure	1.5B	GA												
02070	Noise Control Measures	1.5C	GA												
02070	Schedule of Selective Demolition	1.5D	GA												
02070	Inventory of Items to be Removed														
	and Salvaged	1.5E	GA												
02070	Inventory of Items to be Removed														
	by Government	1.5F	GA												
02070	Photos of Existing Conditions	1.5G	GA												
02070	Record Drawings	1.5H	GA												
02070	Demolition Firm Qualification	1.6A	10												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

Fremont Building Renovation - Phase II NATIONAL IMAGERY & MAPPING AGENCY

SECTION 02300 SUBMITTAL REGISTER Page SR- of

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
02300	Product Data	1.4A	GA												
02300	Samples	1.4B	GA												
02300	Test Reports	1.4 C	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

Fremont Building Renovation - Phase II NATIONAL IMAGERY & MAPPING AGENCY

SECTION 02821 SUBMITTAL REGISTER Page SR- of

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
02821	Product Data	1.3A	GA												
02821	Shop Drawings	1.3B	GA												
02821	Samples	1.3C	GA												
02821	Samples	1.3D	GA												
02821	Product Certificates	1.3E	GA												
02821	Qualification Data	1.3F	GA												
02821	Field Test Reports	1.3G													
02821	Maintenance Data	1.3H													

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

Fremont Building Renovation - Phase II NATIONAL IMAGERY & MAPPING AGENCY

SECTION 02900 SUBMITTAL REGISTER Page SR- of

TITLE AND LOCATION:	CONTRACT NUMBER:	PROJECT TITLE:
NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27 4600 SANGAMORE ROAD BETHESDA, MD 20816	CONTRACTOR NAME & ADDRESS: (TYPED)	RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
02900	Certification of Grass Seed	1.3C	GA												
02900	Qualification Data	1.3D	GA												
02900	Material Test Reports	1.3E	GA												
02900	Maintenance Instructions	1.3F	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved

B: Approved as Noted

C: Approved, resubmittal required

E: Rejected, resubmittal required

NOTES:

GA: Government Approval

IO: Information Only

SECTION 03300 SUBMITTAL REGISTER

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
03300	Product Data	1.4A	GA												
03300	Design Mixes	1.4B	GA												
03300	Steel. Reinf. Shop Drawings	1.4C	GA												
03300	Formwork Shop Drawings	1.4D	GA												
03300	Material Test Reports	1.4E	GA												
03300	Materials Certificates	1.4F	GA												
03300	Minutes, Preinst. Conf.	1.4G	GA												

ENG FORM 4288 - 11/00

ACTION CODES:
A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:
GA: Government Approval
IO: Information Only

Fremont Building Renovation - Phase II NATIONAL IMAGERY & MAPPING AGENCY

SECTION 04810 SUBMITTAL REGISTER Page SR- of

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
04810	Product Data	1.3A	GA												
04810	Samples	1.3 C	GA												
04810	Qualification Data	1.3D	GA												
04810	Material Certificates	1.3F	GA												
04810	Cold Weather Procedure	1.3G	GA												
04810	Material Test Reports	1.3E	GA												

ENG FORM 4288 - 11/00

ACTION CODES:
A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:
GA: Government Approval
IO: Information Only

Fremont Building Renovation - Phase II NATIONAL IMAGERY & MAPPING AGENCY

SECTION 05120 SUBMITTAL REGISTER Page SR- of

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
05120	Product Data	1.4B	GA												
05210	Shop Drawings	1.4C	GA												
05210	Qualification Data	1.4D	GA												
05210	Mill Test Reports	1.4E	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 05310 SUBMITTAL REGISTER

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
05310	Product Data	1.3A	GA												
05310	Shop Drawings	1.3B	GA												
05310	Product Certificates	1.3C	GA												
05310	Welding Certificates	1.3D	GA												
05310	Product Test Reports	1.3E	GA												
05310	Research/Evaluation Reports	1.3F	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 05500 SUBMITTAL REGISTER Page SR- of

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
05500	Product Data	1.3A	GA												
05500	Shop Drawings	1.3B	GA												
05500	Welding Certificates	1.3D	GA												
05500	Qualification Data	1.3E	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 06100 SUBMITTAL REGISTER

Page SR- of

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
06100	Material Certificates	1.4B	GA												
06100	Wood Treatment	1.4C	GA												
06100	Warranty	1.4D	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 06402 SUBMITTAL REGISTER

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
06402	Product Data	1.4A	GA												
06402	Shop Drawings	1.4B	GA												
06402	Samples	1.4C	GA												
06402	Product Certificates	1.4D	GA												
06402	Qualification Data	1.4E	GA												

ENG FORM 4288 - 11/00

ACTION CODES:
A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:
GA: Government Approval
IO: Information Only

SECTION 07160 SUBMITTAL REGISTER

Page SR- of

TITLE AND LOCATION:	CONTRACT NUMBER:	PROJECT TITLE:
NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27 4600 SANGAMORE ROAD BETHESDA, MD 20816	CONTRACTOR NAME & ADDRESS: (TYPED)	RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
07160	Installer Qualifications	1.4A	GA												
07160	Single Source	1.4B	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 07270 SUBMITTAL REGISTER Page SR- of

TITLE AND LOCATION:	CONTRACT NUMBER:	PROJECT TITLE:
NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27 4600 SANGAMORE ROAD BETHESDA, MD 20816	CONTRACTOR NAME & ADDRESS: (TYPED)	RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
07270	Guarantee	1.2C	GA												
07270	Product Data	1.4A	GA												
07270	Shop Drawings	1.4B	GA												
07270	Quality Control	1.4C	GA												
07270	Applicators Qualification	1.4D	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 07552 SUBMITTAL REGISTER

Page SR- of

TITLE AND LOCATION:	CONTRACT NUMBER:	PROJECT TITLE:
NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27 4600 SANGAMORE ROAD BETHESDA, MD 20816	CONTRACTOR NAME & ADDRESS: (TYPED)	RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
07552	Product Data	1.5A	GA												
07552	Shop Drawings	1.5B	GA												
07552	Samples	1.5C	GA												
07552	Installer Certificates	1.5D	GA												
07552	Manufcturer (existing)	1.5E	GA												
07552	Qualification Data	1.5F	GA												
07552	Product Test Reports	1.5G	GA												
07552	Research/Evaluation Reports	1.5I	GA												
07552	Dust/Noise Control	1.5J	GA												
07552	Schedule of Demo	1.5K	GA												
07552	Photos-Videotape	1.5L	GA												
07552	Maintenance Data	1.5M	GA												
07552	Warranties	1.5N	GA												
07552	Inspection Report	1.5O	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 07710 SUBMITTAL REGISTER Page SR- of

TITLE AND LOCATION:	CONTRACT NUMBER:	PROJECT TITLE:
NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27 4600 SANGAMORE ROAD BETHESDA, MD 20816	CONTRACTOR NAME & ADDRESS: (TYPED)	RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
07710	Product Data	1.4A	GA												
07710	Shop Drawings	1.4B	GA												
07710	Samples	1.4C	GA												
07710	Fabricated Sample	1.4D	GA												
07710	Product Test Reports	1.4E	GA												
07710	Warranty	1.4F													

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 07901 SUBMITTAL REGISTER

Page SR- of

TITLE AND LOCATION:	CONTRACT NUMBER:	PROJECT TITLE:
NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27 4600 SANGAMORE ROAD BETHESDA, MD 20816	CONTRACTOR NAME & ADDRESS: (TYPED)	RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
07901	Product Data	1.4B	GA												
07901	Samples	1.4C	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 07910 SUBMITTAL REGISTER

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
07910	Certificates	1.4D	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 08110 SUBMITTAL REGISTER

Page SR- of

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
08110	Product Data	1.4B	GA												
08110	Shop Drawings	1.4C	GA												
08110	Door Schedule	1.4D	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 08305 SUBMITTAL REGISTER Page SR- of

TITLE AND LOCATION:	CONTRACT NUMBER:	PROJECT TITLE:
NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27 4600 SANGAMORE ROAD BETHESDA, MD 20816	CONTRACTOR NAME & ADDRESS: (TYPED)	RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
08305	Product Data	1.4B	GA												
08305	Shop Drawings	1.4C	GA												
08305	Samples	1.4D	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 08311 SUBMITTAL REGISTER

Page SR- of

TITLE AND LOCATION:	CONTRACT NUMBER:	PROJECT TITLE:
NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27 4600 SANGAMORE ROAD BETHESDA, MD 20816	CONTRACTOR NAME & ADDRESS: (TYPED)	RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
08311	Product Data	1.3A	GA												
08311	Shop Drawings	1.3B	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 08410 SUBMITTAL REGISTER Page SR- of

TITLE AND LOCATION:	CONTRACT NUMBER:	PROJECT TITLE:
NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27 4600 SANGAMORE ROAD BETHESDA, MD 20816	CONTRACTOR NAME & ADDRESS: (TYPED)	RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
08410	Product Data	1.4A	GA												
08410	Shop Drawings	1.4B	GA												
08410	Samples	1.4C	GA												
08410	Cutamey Sample	1.4D	GA												
08410	Installer Qualifications	1.4E	GA												
08410	Sealant Compatibility	1.4F	GA												
08410	Field Test Reports	1.4G	GA												
08410	Product Test Reports	1.4H	GA												

ENG FORM 4288 - 11/00

ACTION CODES:
A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:
GA: Government Approval
IO: Information Only

SECTION 08712 SUBMITTAL REGISTER

Page SR- of

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
08712	Product Data	1.3A	GA												
08712	Door Hardware Schedule	1.3B	GA												
08712	Keying Schedule	1.3C	GA												
08712	Product Certificates	1.3D	GA												
08712	Qualification Data	1.3E	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 08800 SUBMITTAL REGISTER

Page SR- of

TITLE AND LOCATION:	CONTRACT NUMBER:	PROJECT TITLE:
NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27 4600 SANGAMORE ROAD BETHESDA, MD 20816	CONTRACTOR NAME & ADDRESS: (TYPED)	RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
08800	Product Data	1.5A	GA												
08800	Samples	1.5B	GA												
08800	Product Certificates	1.5D	GA												
08800	Qualification Data	1.5E	GA												
08800	Adhesion Compatibility	1.5F	GA												
08800	SWRI Certificate	1.5H	GA												
08800	Warranties	1.5I	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 09255 SUBMITTAL REGISTER Page SR- of

TITLE AND LOCATION:	CONTRACT NUMBER:	PROJECT TITLE:
NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27 4600 SANGAMORE ROAD BETHESDA, MD 20816	CONTRACTOR NAME & ADDRESS: (TYPED)	RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
09255	Product Data	1.5B	GA												
09255	Product Certificates	1.5C	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 09310 SUBMITTAL REGISTER

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
09310	Product Data	1.5A	GA												
09310	Tile Samples	1.5C	GA												
09310	Grout Samples	1.5D	GA												
09310	Product Certificates	1.5F													
09310	Shop Drawings	1.5B													
09310	Master Grade Certificates	1.5E													
09310	Qualification Data	1.5G													
09310	Tile Test Reports	1.5H													
09310	Setting Material Test Reports	1.5I													

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 09511 SUBMITTAL REGISTER

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
09511	Product Data	1.3A	GA												
09511	Coordination Drawings	1.3B	GA												
09511	Samples	1.3C	GA												
09511	Qualification Data	1.3D	GA												
09511	Product Test Reports	1.3E	GA												
09511	Research/Evaluation Reports	1.3F	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 09651 SUBMITTAL REGISTER Page SR- of

TITLE AND LOCATION:	CONTRACT NUMBER:	PROJECT TITLE:
NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27 4600 SANGAMORE ROAD BETHESDA, MD 20816	CONTRACTOR NAME & ADDRESS: (TYPED)	RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
09651	Product Data	1.3A	GA												
09651	Samples	1.3B	GA												
09651	Product Certificates	1.3D	GA												
09651	Maintenance Data	1.3E	GA												

ENG FORM 4288 - 11/00

ACTION CODES:
A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:
GA: Government Approval
IO: Information Only

SECTION 09681 SUBMITTAL REGISTER

Page SR- of

TITLE AND LOCATION:	CONTRACT NUMBER:	PROJECT TITLE:
NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27 4600 SANGAMORE ROAD BETHESDA, MD 20816	CONTRACTOR NAME & ADDRESS: (TYPED)	RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
09681	Product Data	1.3	GA												
09681	Shop Drawings	1.3	GA												
09681	Samples	1.3	GA												
09681	Product Schedule	1.3	GA												
09681	Maintenance Data	1.3	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 09900 SUBMITTAL REGISTER Page SR- of

TITLE AND LOCATION:	CONTRACT NUMBER:	PROJECT TITLE:
NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27 4600 SANGAMORE ROAD BETHESDA, MD 20816	CONTRACTOR NAME & ADDRESS: (TYPED)	RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
09900	Product Data	1.4A	GA												
09900	Samples	1.4B	GA												
09900	Qualification Data	1.4C	GA												

ENG FORM 4288 - 11/00

ACTION CODES:
A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:
GA: Government Approval
IO: Information Only

SECTION 10155 SUBMITTAL REGISTER

TITLE AND LOCATION:	CONTRACT NUMBER:	PROJECT TITLE:
NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27 4600 SANGAMORE ROAD BETHESDA, MD 20816	CONTRACTOR NAME & ADDRESS: (TYPED)	RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
10155	Product Data	1.3A	GA												
10155	Shop Drawings	1.3B	GA												
10155	Samples	1.3C	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 10200 SUBMITTAL REGISTER Page SR- of

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
10200	Product Data	1.5A	GA												
10200	Shop Drawings	1.5B	GA												
10200	Samples	1.5C	GA												
10200	Product Certificates	1.5E	GA												
10200	Sample for Verification	1.5D	GA												
10200	Qualification Data	1.5F	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

Fremont Building Renovation - Phase II NATIONAL IMAGERY & MAPPING AGENCY

SECTION 10270 SUBMITTAL REGISTER

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
10270	Product Data	1.4A	GA												
10270	Shop Drawings	1.4B	GA												
10270	Samples	1.4C													
10270	Product Certificates	1.4D													
10270	Qualification Data	1.4E													
10270	Product Test Reports	1.4F													

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

Fremont Building Renovation - Phase II NATIONAL IMAGERY & MAPPING AGENCY

SECTION 10522 SUBMITTAL REGISTER Page SR- of

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
10522	Product Data	1.3B	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

Fremont Building Renovation - Phase II NATIONAL IMAGERY & MAPPING AGENCY

SECTION 10801 SUBMITTAL REGISTER

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
10801	Product Data	1.3B	GA												
10801	Schedule	1.3C	GA												
10801	Maintenance Data	1.3D	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

Fremont Building Renovation - Phase II NATIONAL IMAGERY & MAPPING AGENCY

SECTION 12496 SUBMITTAL REGISTER

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
12496	Instructions	1.3A	GA												
12496	Test Reports	1.3B	GA												
12496	Color Selection Samples	1.3C	GA												
12496	Sample Installation	1.3D	GA												
12496	Operations and Maintenance Manuals	1.3E	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 12511 SUBMITTAL REGISTER

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
12511	Product Data	1.3B	GA												
12511	Shop Drawings	1.3C	GA												
12511	Samples	1.3D	GA												
12511	Maintenance Data	1.3G	GA												
12511	Samples for Verification	1.3E	GA												
12511	Schedule of Horizontal Louver Blinds	1.3F	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 13330 SUBMITTAL REGISTER

TITLE AND LOCATION:	CONTRACT NUMBER:	PROJECT TITLE:
NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27 4600 SANGAMORE ROAD BETHESDA, MD 20816	CONTRACTOR NAME & ADDRESS: (TYPED)	RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (£)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
13330	Division 1	1.4A	GA												
13330	Test Certifications and Instructions	1.4B	GA												
13330	Shop Drawings	1.4C	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 14200 SUBMITTAL REGISTER

Page SR- of

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
14200	Shop Drawings	1.3	GA												
14200	Wiring Diagrams	1.3	GA												
14200	Manuals	1.3	GA												
14200	Qualifications	1.3	GA												
14200	Guarantee	1.3	GA												
14200	Samples and Data	1.3	GA												
14200	Proof of Competence	1.3	GA												

ENG FORM 4288 - 11/00

ACTION CODES:
A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:
GA: Government Approval
IO: Information Only

SECTION 15010 SUBMITTAL REGISTER

Page SR-

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
15010	Coordination Drawings	1.3C	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 15130 SUBMITTAL REGISTER

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
15130	Product Data	1.3B	GA												
15130	Maintenance Data	1.3C	GA												
15130	Calibration Data	1.3D	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 15140 SUBMITTAL REGISTER

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
15140	Product Data	1.3B	GA												
15140	Shop Drawings	1.3C	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 15170 SUBMITTAL REGISTER

Page SR-

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
15170	Product Data	1.3B	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 15171 SUBMITTAL REGISTER

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
15171	Shop Drawings	1.4B	GA												
15171	Product Data	1.4C	GA												
15171	Manufacturer's Installation Instructions	1.4D	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 15190 SUBMITTAL REGISTER

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
15190	Product Data	1.3A	GA												
15190	Samples	1.3C	GA												
15190	Schedules	1.3D	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 15240 SUBMITTAL REGISTER

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
15240	Contractor's Certification	1.3B	GA												
15240	Manufacturer's Certification	1.3C	GA												
15240	Product Data	1.3D	GA												
15240	Shop Drawings	1.3E	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 15250 SUBMITTAL REGISTER

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
15250	Product Data	1.3A	GA												
15250	Maintenance Data	1.3B	GA												
15250	Samples	1.3C	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 15410 SUBMITTAL REGISTER

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
15410	Manufacturers Data	1.3A	GA												
15410	Coordinated Drawings	1.3B	GA												
15410	Permits	1.3C	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 15440 SUBMITTAL REGISTER

Page SR-

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
15440	Product Data	1.3B	GA												
15440	Shop Drawings	1.3C	GA												
15440	Maintenance Data	1.3D	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 15510 SUBMITTAL REGISTER

Page SR-

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
15510	Product Data	1.3B	GA												
15510	Shop Drawings	1.3C	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 15520 SUBMITTAL REGISTER

Page SR-

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
15520	Product Data	1.3B	GA												
15520	Shop Drawings	1.3C	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 15830 SUBMITTAL REGISTER

Page SR-

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
15830	Product Data	1.3A	GA												
15830	Shop Drawings	1.3B	GA												
15830	Samples	1.3C	GA												
15830	Maintenance Data	1.3D	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 15855 SUBMITTAL REGISTER

Page SR-

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
15855	Product Data	1.3B	GA												
15855	Shop Drawings	1.3C	GA												
15855	Maintenance Data	1.3D	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 15860 SUBMITTAL REGISTER

Page SR-

TITLE AND LOCATION:	CONTRACT NUMBER:	PROJECT TITLE:
NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27 4600 SANGAMORE ROAD BETHESDA, MD 20816	CONTRACTOR NAME & ADDRESS: (TYPED)	RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
15860	Product Data	1.3B	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved

B: Approved as Noted

C: Approved, resubmittal required

E: Rejected, resubmittal required

NOTES:

GA: Government Approval

IO: Information Only

SECTION 15870 SUBMITTAL REGISTER

Page SR-

TITLE AND LOCATION:	CONTRACT NUMBER:	PROJECT TITLE:
NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27 4600 SANGAMORE ROAD BETHESDA, MD 20816	CONTRACTOR NAME & ADDRESS: (TYPED)	RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
15870	Product Data	1.3B	GA												
15870	Maintenance Data	1.3C	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 15885 SUBMITTAL REGISTER

Page SR-_____ of _____

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
15885	Product Data	1.3B	GA												
15885	Shop Drawings	1.3C	GA												
15885	Samples	1.3D	GA												
15885	Maintenance Data	1.3E	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 15890 SUBMITTAL REGISTER

Page SR-_____ of _____

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
15890	Shop Drawings	1.3B,C	GA												
15890	Shop Drawings	1.3D,E	GA												
15890	Certifications	1.3F	GA												
15890	Field Manuals	1.3G	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 15935 SUBMITTAL REGISTER

Page SR-_____ of _____

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
15935	Product Data	1.3A	GA												
15935	Certifications	1.3B	GA												
15935	Shop Drawings	1.3C	GA												
15935	Samples	1.3D	GA												
15935	Maintenance Data	1.3E	GA												
15935	Commissioning Test Plan	1.3F	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 15940 SUBMITTAL REGISTER

Page SR-_____ of _____

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
15940	Product Data	1.3B	GA												
15940	Schedule	1.3C	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 15950 SUBMITTAL REGISTER

Page SR-_____ of _____

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
15950	Prequalifications	1.3A	GA												
15950	Shop Drawings	1.3C,E	GA												
15950	Manufacturer's Data	1.3D	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 15990 SUBMITTAL REGISTER

Page SR-_____ of _____

TITLE AND LOCATION:

NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27
4600 SANGAMORE ROAD
BETHESDA, MD 20816

CONTRACT NUMBER:

CONTRACTOR NAME & ADDRESS: (TYPED)

PROJECT TITLE:

RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
15990	Test Reports	1.3B	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 16010 SUBMITTAL REGISTER

Page SR-_____ of _____

TITLE AND LOCATION:	CONTRACT NUMBER:	PROJECT TITLE:
NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27 4600 SANGAMORE ROAD BETHESDA, MD 20816	CONTRACTOR NAME & ADDRESS: (TYPED)	RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
16010	Submittal List	1.3B	GA												
16010	Coordination Drawings	1.3C	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 16110 SUBMITTAL REGISTER

Page SR-_____ of _____

TITLE AND LOCATION:	CONTRACT NUMBER:	PROJECT TITLE:
NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27 4600 SANGAMORE ROAD BETHESDA, MD 20816	CONTRACTOR NAME & ADDRESS: (TYPED)	RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
16110	Shop Drawings	1.3C	GA												
16110	Samples	1.3D	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 16120 SUBMITTAL REGISTER

Page SR-_____ of _____

TITLE AND LOCATION:	CONTRACT NUMBER:	PROJECT TITLE:
NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27 4600 SANGAMORE ROAD BETHESDA, MD 20816	CONTRACTOR NAME & ADDRESS: (TYPED)	RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
16120	Product Data	1.3B	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 16130 SUBMITTAL REGISTER

Page SR-_____ of _____

TITLE AND LOCATION:	CONTRACT NUMBER:	PROJECT TITLE:
NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27 4600 SANGAMORE ROAD BETHESDA, MD 20816	CONTRACTOR NAME & ADDRESS: (TYPED)	RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
16130	Product Data	1.3B	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 16135 SUBMITTAL REGISTER Page SR-_____ of _____

TITLE AND LOCATION:	CONTRACT NUMBER:	PROJECT TITLE:
NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27 4600 SANGAMORE ROAD BETHESDA, MD 20816	CONTRACTOR NAME & ADDRESS: (TYPED)	RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
16135	Product Data	1.3A	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 16160 SUBMITTAL REGISTER Page SR-_____ of _____

TITLE AND LOCATION:	CONTRACT NUMBER:	PROJECT TITLE:
NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27 4600 SANGAMORE ROAD BETHESDA, MD 20816	CONTRACTOR NAME & ADDRESS: (TYPED)	RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
16160	Product Data	1.3B	GA												
16160	Shop Drawings	1.3C	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 16190 SUBMITTAL REGISTER Page SR-_____ of _____

TITLE AND LOCATION:	CONTRACT NUMBER:	PROJECT TITLE:
NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27 4600 SANGAMORE ROAD BETHESDA, MD 20816	CONTRACTOR NAME & ADDRESS: (TYPED)	RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
16190	Product Data	1.3B	GA												
16190	Shop Drawings	1.3C	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 16195 SUBMITTAL REGISTER Page SR-_____ of _____

TITLE AND LOCATION:	CONTRACT NUMBER:	PROJECT TITLE:
NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27 4600 SANGAMORE ROAD BETHESDA, MD 20816	CONTRACTOR NAME & ADDRESS: (TYPED)	RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
16195	Product Data	1.3B	GA												
16195	Samples	1.3C	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 16440 SUBMITTAL REGISTER Page SR-_____ of _____

TITLE AND LOCATION:	CONTRACT NUMBER:	PROJECT TITLE:
NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27 4600 SANGAMORE ROAD BETHESDA, MD 20816	CONTRACTOR NAME & ADDRESS: (TYPED)	RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
16440	Product Data	1.3B	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 16450 SUBMITTAL REGISTER Page SR-_____ of _____

TITLE AND LOCATION:	CONTRACT NUMBER:	PROJECT TITLE:
NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27 4600 SANGAMORE ROAD BETHESDA, MD 20816	CONTRACTOR NAME & ADDRESS: (TYPED)	RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
16450	Product Data	1.3B	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 16461 SUBMITTAL REGISTER Page SR-_____ of _____

TITLE AND LOCATION:	CONTRACT NUMBER:	PROJECT TITLE:
NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27 4600 SANGAMORE ROAD BETHESDA, MD 20816	CONTRACTOR NAME & ADDRESS: (TYPED)	RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
16461	Product Data	1.3B	GA												
16461	Certified Test Reports	1.3C	GA												
16461	Shop Drawings	1.3D	GA												
16461	Wiring Diagram	1.3E	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 16470 SUBMITTAL REGISTER Page SR-_____ of _____

TITLE AND LOCATION:	CONTRACT NUMBER:	PROJECT TITLE:
NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27 4600 SANGAMORE ROAD BETHESDA, MD 20816	CONTRACTOR NAME & ADDRESS: (TYPED)	RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
16470	Product Data	1.3B	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 16475 SUBMITTAL REGISTER Page SR-_____ of _____

TITLE AND LOCATION:	CONTRACT NUMBER:	PROJECT TITLE:
NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27 4600 SANGAMORE ROAD BETHESDA, MD 20816	CONTRACTOR NAME & ADDRESS: (TYPED)	RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
16475	Product Data	1.3B	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 16482 SUBMITTAL REGISTER Page SR-_____ of _____

TITLE AND LOCATION:	CONTRACT NUMBER:	PROJECT TITLE:
NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27 4600 SANGAMORE ROAD BETHESDA, MD 20816	CONTRACTOR NAME & ADDRESS: (TYPED)	RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
16482	Product Data	1.3B	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 16510 SUBMITTAL REGISTER Page SR-_____ of _____

TITLE AND LOCATION:	CONTRACT NUMBER:	PROJECT TITLE:
NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27 4600 SANGAMORE ROAD BETHESDA, MD 20816	CONTRACTOR NAME & ADDRESS: (TYPED)	RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
16510	Product Data	1.3B	GA												
16510	Shop Drawings	1.3C	GA												
16510	Manuals	1.3D	GA												
16510	Computer Generated Plot	1.3E	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 16670 SUBMITTAL REGISTER Page SR-_____ of _____

TITLE AND LOCATION:	CONTRACT NUMBER:	PROJECT TITLE:
NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27 4600 SANGAMORE ROAD BETHESDA, MD 20816	CONTRACTOR NAME & ADDRESS: (TYPED)	RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
16670	Certification	1.3B	GA												
16670	Shop Drawings	1.3C	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 16760 SUBMITTAL REGISTER Page SR-_____ of _____

TITLE AND LOCATION:	CONTRACT NUMBER:	PROJECT TITLE:
NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27 4600 SANGAMORE ROAD BETHESDA, MD 20816	CONTRACTOR NAME & ADDRESS: (TYPED)	RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
16760	Product Data	1.3A	GA												
16760	Shop Drawings	1.3B	GA												
16760	System Labeling Schedules	1.3C	GA												
16760	Samples	1.3D	GA												
16760	Product Certificates	1.3E	GA												
16760	Qualification Data	1.3F	GA												
16760	Field Quality Control Test Report	1.3G	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

SECTION 16856 SUBMITTAL REGISTER Page SR-_____ of _____

TITLE AND LOCATION:	CONTRACT NUMBER:	PROJECT TITLE:
NATIONAL IMAGERY & MAPPING AGENCY SIIBF D-27 4600 SANGAMORE ROAD BETHESDA, MD 20816	CONTRACTOR NAME & ADDRESS: (TYPED)	RENOVATE FREMONT BUILDING - Construction phase II

SPEC SECTION NUMBER (a)	DESCRIPTION OF SUBMITTAL (b)	SPEC PARA NUMBER (c)	CLASSIFICATION (d)	REVIEWER (e)	CONTROL NUMBER (f)	PLANNED SUBMITTAL DATE (g)	ACTION CODE (h)	DATE OF ACTION (i)	DATE FWD TO APPR AUTH (j)	DATE FWD TO OTHER REVIEWER (k)	DATE RECD TO OTHER REVIEWER (l)	ACTION CODE (m)	DATE OF ACTION (n)	MAILED TO CONTR (o)	REMARKS (p)
16856	Product Data	1.3B	GA												
16856	Coordination Drawings	1.3C	GA												
16856	Wiring Diagrams	1.3D	GA\												
16856	Qualification	1.3E	GA												
16856	Field Test Report	1.3F	GA												

ENG FORM 4288 - 11/00

ACTION CODES:

A: Approved
B: Approved as Noted
C: Approved, resubmittal required
E: Rejected, resubmittal required

NOTES:

GA: Government Approval
IO: Information Only

TRANSMITTAL OF SHOP DRAWINGS, EQUIPMENT DATA, MATERIAL SAMPLES, OR MANUFACTURER'S CERTIFICATES OF COMPLIANCE	TRANSMITTAL DATE:	TRANSMITTAL NUMBER:

SECTION I - REQUEST FOR APPROVAL OF THE FOLLOWING ITEMS

TO: NIMA Bethesda C/SIIBF-Construction Services 4600 Sangamore Road D-27 Bethesda, MD 20816	FROM:	CONTRACT NUMBER:	CHECK ONE: New Transmittal Resubmittal of Transmittal #

ITEM NUMBER	DESCRIPTION OF ITEM SUBMITTED		MANUF. OR CONTR. CAT., DRAWING, OR BROCHURE	NUMBER OF COPIES	SPEC PARAGRAPH NUMBER	DRAWING SHEET NO.	FOR CONTRACTOR USE	VARIATION (Check if Applicable)	GOVERNMENT APPROVAL CODE

REMARKS:	I certify that the above submitted items have been reviewed in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise stated.
Date received from contractor:	
Date returned to contractor:	NAME, TITLE, AND SIGNATURE OF CONTRACTOR

SECTION II - APPROVAL ACTION

ACTION CODES:		
A: Approved as Submitted - No Exceptions Taken B: Approved - Except as Noted	C: Approved - Amend and Resubmit E: Disapproved - Resubmit	
ENCLOSURES RETURNED: v. 09NOV00	NAME, TITLE, AND SIGNATURE OF APPROVING AUTHORITY C/SIIBF-Construction Services	DATE (Mo/Day/Yr):

SECTION 01004(Abr) - CONTRACTOR QUALITY CONTROL

PART 1 - GENERAL

1.1 REFERENCES: 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.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 329 (Current Edition at Contract Award) Use in Evaluation of Testing and Inspection Agencies as Used in Construction

1.2 PAYMENT: All costs associated with providing and maintaining an effective Quality Control program shall be included in overhead costs of the contract.

1.3 DEFINITIONS:

A. Quality Management (QM): All quality control and quality assurance activities on both the part of the Contractor and the Government to achieve that quality which is established by the contract.

B. Quality Control (QC): The Contractor's management and control of his own, his suppliers', and his subcontractors' activities to comply with the contract.

C. Quality Assurance (QA): The means by which the Government fulfills its responsibility in assuring that the Contractor's QC is functioning and, through reviews, surveillance and tests, assures the completed product complies with the contract.

PART 2- PRODUCTS -NOT USED

PART 3 - EXECUTION

3.1 GENERAL: The Contractor is responsible for quality control and shall establish and maintain an effective quality control system in compliance with the Contract Clause entitled "Inspection of Construction." The quality control system shall consist of plans, procedures, and organization necessary to produce an end product that complies with the contract requirements. The system shall cover all construction operations, both on-site and off-site, and shall be keyed to the proposed construction sequence.

3.2 QUALITY CONTROL PLAN (QCP): The Contractor shall furnish for approval the QCP proposed to implement the requirements of the clause of this contract entitled *Inspection of Construction*. The plan shall identify personnel, procedures, control, instructions, test, records, and forms to be used. Construction will be permitted to begin only after acceptance of the QCP or acceptance of an interim plan applicable to the particular feature of work to be started. In the event a special requirement in the contract necessitates the need for a variance of the QCP, the Contractor shall submit, at no additional cost to the Government, a new QCP to the COR.

A. Content: The QCP shall include, as a minimum, the following information to cover all construction operations, both on-site and off-site, including work by subcontractors, fabricators, suppliers and purchasing agents:

1. Supervision: The name, qualifications (in resume format), duties, responsibilities, and authorities of the assigned Project Manager and Superintendent as required by specifications section *General Technical Requirements*.

2. Description: A description of the Contractor Quality Control organization (CQC staff), including a chart showing lines of authority.

3. Procedures: Procedures for tracking construction deficiencies from identification through acceptable corrective action. These procedures will establish verification that identified deficiencies have been corrected.

4. Reports: Reporting procedures, including proposed reporting formats.

B. Acceptance: Acceptance of the Contractor's plan is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. The Government reserves the right to require the Contractor to make changes in his QCP and operations including removal of personnel, as necessary, to obtain the quality specified.

C. Notification of Changes: After acceptance of the QCP, the Contractor shall notify the COR in writing a minimum of seven (7) days prior to any proposed change. Proposed changes are subject to acceptance by the Contracting Officer.

3.3 COORDINATION MEETING: After the pre-construction conference, before start of construction, and prior to acceptance by the Government of the QCP, the Contractor shall meet with the COR and discuss the Contractor's quality control system. During the meeting, a mutual understanding of the system details shall be developed, including the forms for recording the CQC operations, control activities, testing, administration of the system for both on-site and off-site work, and the interrelationship of Contractor's management and control with the Government's Quality Assurance. There may be occasions when subsequent conferences will be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures that may require corrective action by the Contractor.

3.4 QUALITY CONTROL ORGANIZATION:

A. Quality Control Manager (QCM): The Contractor shall identify an individual within his organization who shall be at the work site at all times during construction operations and who shall be responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor. An alternate for the QCM shall be appointed to serve in the QCM's absence and shall have the same qualifications as the QCM. The Project Manager described in specifications section *General Technical Requirements* and the QCM described here shall not be the same individual. The QCM shall be assigned, primarily, as the QCM but may have duties as the project superintendent in addition to quality control.

1. QCM Qualifications: The QCM project manager shall have a minimum of 5 years construction experience and/or construction management experience on contracts similar to this contract.

B. Quality Control Staff: The Contractor shall provide a QC staff with complete authority to take any action necessary to ensure compliance with the contract.

1. QC Staff Qualifications: The minimum requirements for the QC staff are outlined below. These minimum requirements will not necessarily assure an adequate staff to meet the CQC

requirements at all times during construction. The actual strength of the QC staff may vary during any specific work period to cover the needs of the work period. When necessary for a proper CQC organization, the Contractor will add additional staff at no cost to the Government. This listing of minimum staff in no way relieves the Contractor of meeting the basic requirements of quality construction in accordance with contract requirements. All QC staff members shall be subject to acceptance by the COR.

C. Supplemental Personnel: The Contractor shall provide specialized personnel as part of the CQC organization as required to assist and report to the QCM. Each person will be responsible for assuring the construction complies with the contract requirements for their area of specialization.

D. Organizational Changes: The Contractor shall obtain the COR's approval before replacing any member of the QC staff. Requests shall include the names, qualifications, duties, and responsibilities of each proposed replacement.

3.5 SUBMITTALS: See specifications section *Submittals*.

3.6 CONTROL PHASES: Contractor Quality Control is the means by which the Contractor ensures that the construction, to include that of sub-Contractors and suppliers, complies with the requirements of the contract. The controls shall be adequate to cover all construction operations, including both on-site and off-site fabrication, and will be keyed to the proposed construction sequence and identified on the progress schedule.

3.7 TESTS: All tests required by the contract documents shall be performed by the Contractor at his expense to include associated costs such as furnishing/transporting samples for testing, laboratory fees, and cost for re-testing.

A. Testing Procedure: The Contractor shall perform tests specified or required to verify that control measures are adequate to provide a product which conforms to contract requirements. Testing includes operation and/or acceptance tests when specified. The Contractor shall procure the services of a testing laboratory acceptable to the COR or establish a suitable testing laboratory at the project site. A list of tests to be performed shall be furnished as a part of the CQC Plan. The list shall give the test name, frequency, specification paragraph containing the test requirements, the personnel and laboratory responsible for each type of test, and an estimate of the number of tests required. The Contractor shall perform the following activities and record and provide the following data:

1. Verify that testing procedures comply with contract requirements.

2. Verify that facilities and testing equipment are available and comply with testing standards.

3. Check test instrument calibration data against certified standards.

4. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.

5. Results of all tests taken, both passing and failing tests, will be recorded on the Quality Control report for the date taken and the Contractor's Daily Report. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test will be given. Actual test reports may be submitted later, if approved by the COR, with a reference to the test number and date taken. An information copy of tests performed by an off-site or

commercial test facility will be provided directly to the COR. Failure to submit timely test reports, as stated, may result in nonpayment for related work performed and disapproval of the test facility for this contract.

B. Testing Laboratories: Capability Check: The Government reserves the right to check laboratory equipment in the proposed laboratory for compliance with the standards set forth in the contract specifications and to check the laboratory technician's testing procedures and techniques. Laboratories utilized for testing concrete and steel shall meet criteria detailed in ASTM E 329.

C. On-Site Laboratory: The Government reserves the right to utilize the Contractor's control testing laboratory and equipment to make assurance tests and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the Government.

3.8 COMPLETION INSPECTION: At the completion of all work or any increment thereof established by a completion time stated in the Special Clause entitled "Commencement, Prosecution, and Completion of Work," or stated elsewhere in the specifications, the QCM shall conduct an inspection of the work and develop a "punch list" of items which do not conform to the approved plans and specifications. Such a list of deficiencies shall be included in the CQC documentation, as required by paragraph *Interim Documentation* below, and shall include the estimated date by which the deficiencies will be corrected. The QCM or staff shall make a second inspection to ascertain that all deficiencies have been corrected and to notify the COR that the work is ready for final acceptance inspection. These inspections and any deficiency corrections required by this paragraph will be accomplished within the time stated for completion of the entire work or any particular increment thereof if the project is divided into increments by separate completion dates.

3.9 INTERIM DOCUMENTATION: The Contractor shall maintain current records of quality control operations, activities, and tests performed, including the work of sub-Contractors and suppliers. These records shall be on the Contractor Daily Report and shall include factual evidence that required quality control activities and/or tests have been performed, including but not limited to the following:

1. Contractor/Sub-Contractor and their area of responsibility.

2. Operating plant/equipment with hours worked, idle, or down for repair.

3. Work performed today, giving location, description, and by whom.

4. Test and/or control activities performed with results and references to specifications/plan requirements. List deficiencies noted along with corrective action.

5. Material received with statement as to its acceptability and storage.

6. Identify submittals reviewed, with contract reference, by whom, and action taken.

7. Off-site surveillance activities, including actions taken.

8. Job safety evaluations stating what was checked, results, and instructions or corrective actions.

9. List instructions given/received and conflicts in plans and/or specifications.

10. Contractor's verification statement.

11. These records shall indicate a description of trades working on the project; instructions from the COR; the number of personnel working; weather conditions encountered; and any delays encountered. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in the work and workmanship comply with the contract. The original and one copy of these records in report form shall be furnished to the COR daily within 24 hours after the date(s) covered by the report, except that reports need not be submitted for days on which no work is performed. As a minimum, one report shall be prepared and submitted for every seven days of no work and on the last day of a no work period. All calendar days shall be accounted for throughout the life of the contract. The first report following a day of no work shall be for that day only. Reports shall be signed and dated by the QCM. The report from the QCM shall include copies of test reports and copies of reports prepared by all subordinate quality control personnel.

3.10 NOTIFICATION OF NONCOMPLIANCE: The COR will notify the Contractor in writing of any detected noncompliance with the foregoing requirements. The Contractor shall, after receipt of such notice, immediately take corrective action. Such notice, when delivered to the Contractor at the site of the work, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue a suspension of work order or cure notice until satisfactory corrective action has been taken. No part of the time lost due to such suspensions shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

3.11 FINAL DOCUMENTATION: Upon completion of the work but prior to final acceptance of the work by the Government, the Contractor shall submit all final project documentation required by the contract documents.

A. Record Drawings: The Contractor shall maintain a minimum of one (1) set of master prints on the work site, on which he shall carefully and neatly record all deviations from the original contract drawings which are made to each phase of construction as the work progresses. The Contractor is responsible for noting all changes and corrections on these record drawings promptly as the changes occur, but in no case less often than on a weekly basis. The record drawings shall indicate all changes and modifications incorporated into the work and the following:

1. The actual location of all subsurface utility lines, type of material actually installed, sizes of major lines, etc. shall be shown. The record drawings shall also indicate, by offset dimensions to permanently fixed surface features, both ends of each run and each change in direction. Valves, splice boxes and similar appurtenances shall be located by dimensions along the utility run from a reference point. The average depth of each run below the surface shall also be recorded.

2. Any shop drawings which constitute part of the design shall be included in the record drawings.

3. A list containing the manufacturer and model number of all major items of equipment shall be included in the record drawings.

4. The notated record drawings shall be certified as to their correctness by the signature of the Contractor and submitted to the COR for review and approval. Approval of the record drawings must be obtained before final payment is made.

B. WARRANTIES: In accordance with the clause of this contract entitled *Warranty of Construction*, the Contractor shall submit six (6) copies of all material and/or equipment warranties indicating the terms of the warranty and the starting/ending dates.

C. OPERATION/MAINTENANCE DATA: Six (6) copies of all operation and maintenance instructions and other pertinent data required by the specifications shall be submitted to the COR.

END OF SECTION

SECTION 01005(Abr) - ENVIRONMENTAL PROTECTION

PART 1 -GENERAL

1.1 REFERENCES:

AIR FORCE REGULATIONS

AFR 67-12	Storage and Handling of Compressed Gases and Liquids in Cylinders and of Cylinders.

CODE OF FEDERAL REGULATIONS

40 CFR 81.156	Southern Maryland Interstate Air Quality Control Region
40 CFR 82.156	EPA Stratospheric Ozone Protection Regulations, August 26, 1994
49 CFR 173.301	General Requirements for Shipment of Compressed Gases in Cylinders

DEFENSE LOGISTICS AGENCY REGULATION

DLAR 4145.25	Storage and Handling of Compressed Gases and Liquids in Cylinders

DEPARTMENT OF DEFENSE REGULATION

DODR 4000.25-1-M	Military Standard Requisitioning and Issue Procedures (MILSTRIP)

MILITARY STANDARDS

MIL-STD-129L	Military Standard Marking for Shipment and Storage

1.2 GENERAL: The work covered by this section consists of the Contractor furnishing all labor, materials, and equipment, and performing all work as required for the prevention of environmental pollution during and as a result of construction operations under this contract. For the purpose of this specification, environmental pollution is defined as any man-made alteration to the existing environment, either directly or indirectly, that adversely affects the natural quality or quantity of the environment for life forms.

1.3 APPLICABLE REGULATIONS: In order to prevent and to provide for abatement and control of any environmental pollution arising from construction activities, the Contractor and sub-Contractors, in the performance of this contract, shall comply with all applicable Federal, State and local laws and regulations concerning environmental pollution control and abatement in accordance with the clause of this contract entitled *Permits and Responsibilities*, as well as the specific requirements stated elsewhere in the contract, particularly those stated in section 02050, *Demolition*.

1.4. NOTIFICATIONS: The COR shall notify the Contractor in writing of any non-compliance with the foregoing provisions and the action to be taken. The Contractor shall, after receipt of such notice, immediately take corrective action. Such notice, when delivered to the Contractor or his authorized representative at the site of the work, shall be deemed sufficient for the purpose. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to any such stop order shall be made the subject of a claim for extension of time or for excess costs or damages by the Contractor unless it is later determined that the Contractor was in compliance.

1.5 SUBCONTRACTORS: Compliance with the provisions of this section by sub-Contractors will be the responsibility of the Contractor.

1.6 ENVIRONMENTAL PROTECTION PLAN: In accordance with specification section *Submittals* paragraph *Administrative Submittals*, the Contractor shall prepare, and submit for Government approval, a comprehensive environmental protection plan describing all proposed measures for implementing the requirements of this section. The plan shall allow for a meeting with the COR and Government environmental and safety representatives to develop a mutual understanding relative to compliance with these provisions and administration of the environmental pollution control program.

1.7 CONTROL OF AIR POLLUTANTS: The Contractor shall comply with all provisions of the *Clean Air Act (as amended)* applicable to the work to be performed under this contract and the following:

A. Burning: Open burning of trash, refuse, debris and vegetation is prohibited.

B. Sulfur Dioxide Emissions: The Contractor shall not use any fuels with sulfur content exceeding 1% by weight, except as may be required by the technical specifications.

C. Ozone Depleting Chemicals: The Contractor shall comply with the applicable requirements of *Sections 608 and 609 of the Clean Air Act as amended (42 U.S.C. 7671g and 7671h)* as each or both apply to this contract.

D. Dust Control: The Contractor shall maintain all work areas free from dust that would contribute to air pollution. Approved temporary methods of stabilization consisting of sprinkling, chemical treatment, light bituminous treatment, polyethylene barriers, or similar methods shall be permitted to control dust. Sprinkling, where used, must be repeated at such intervals as to keep all parts of the disturbed area at least damp at all times. Dust control shall be performed as the work proceeds and whenever a dust nuisance or hazard occurs.

1.8 PROTECTION OF WATER RESOURCES AND WASTEWATER: The Contractor shall not pollute streams, lakes, or reservoirs with fuels, oils, bitumen, calcium chloride, acid construction wastes or other harmful materials. It is the responsibility of the Contractor to investigate and comply with all Federal, State, County and Municipal laws concerning pollution of rivers and streams. All work under this contract shall be performed in such a manner that objectionable conditions will not be created in streams through, or adjacent to, the project area.

1.9 EROSION CONTROL: The Contractor shall comply with the following requirements:

A. No disturbed area will be left denuded for more than 90 days unless otherwise authorized by the Contracting Officer.

B. All erosion and sediment control measures are to be placed prior to or as the first step in staging and de-staging.

C. All temporary earth berms, diversions, and sediment dams are to be mulched and seeded for temporary vegetation cover within 10 days after grading. Straw or hay mulch is required. The same applies to all soil stockpiles.

D. All sediment control measures are to remain in place until permission for their removal has been obtained from the COR

E. During construction, all storm water sewer inlets will be protected by sediment and traps, maintained and modified as required by construction progress.

F. Any disturbed area not covered by paragraph 1.8 above and not paved, sodded, or built upon by 1 November of any calendar year, or disturbed after that date, is to be seeded within 15 days with oats, abuzzi rye, or equivalent and mulched with hay or straw at the rate of two tons per acre.

1.10 PROTECTION OF LAND RESOURCES: In accordance with the clause of this contract entitled *Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements*, the Contractor shall protect and preserve the land resources within the project boundaries and outside the limits of permanent work under this contract in their present condition and/or restore these resources to a condition after completion of construction that will appear to be natural and not detract from the appearance of the project. Insofar as possible, the Contractor shall confine his construction activities to areas defined by the plans and specifications or to be cleared for other operations. The Contractor shall also comply with the following:

A. Protection of Trees and other Vegetation to be Retained: The Contractor shall be responsible for the protection of the tops, trunks, and roots of all existing vegetation that is to be retained on the site. Protection shall be maintained until all work in the vicinity has been completed and shall not be released without the consent of the COR. If the COR finds that the protective devices are insufficient to protect the vegetation retained on the site, additional protection devices shall be installed to ensure adequate protection.

1. Heavy equipment, vehicular traffic, or stockpiling of any materials shall not be permitted within the drip line of trees to be retained.

2. No toxic materials may be stored within 100 feet from the drip line of trees to be retained.

3. Unless specified on the plans to be removed, the Contractor shall not deface, injure, or destroy trees or shrubs, nor remove or cut them without written permission from the Contracting Officer. No ropes, cables, or guys shall be fastened to or attached to any existing trees for anchorage.

4. No protective devices, signs, utility boxes, or other objects shall be nailed to trees to be retained.

5. Devices: Any device may be used which will effectively protect the roots, trunk and top of the vegetation retained on the site. The less formidable the barrier used, the greater care that must be taken to avoid inflicting damage. Personnel working in the vicinity of the vegetation must be instructed to honor the protective devices.

B. Restoration of Landscape Damage: Any tree or other landscape feature scarred or damaged by the Contractor's equipment or operations shall be restored as nearly as possible to its original condition at the Contractor's expense. The COR will decide what method of restoration shall be used, and

whether damaged trees shall be treated and healed or removed and disposed of. All scars made on trees, not designated on the plan to be removed, by equipment, construction operations, or by the removal of limbs larger than 1 inch in diameter shall be coated as soon as possible with an approved tree wound dressing. All trimming or pruning shall be performed by experienced workmen with saws or pruning shears and in a manner approved be the COR. Tree trimming with axes will not be permitted. Trees that are to remain, either within or outside the established construction site boundary, that are subsequently damaged by the Contractor and are beyond saving in the opinion of the COR, shall be immediately removed and replaced with a nursery grown tree of the same species. Replacement trees shall measure no less than 2 inches in diameter at 6 inches above the ground level.

1.11 PROTECTION OF WILDLIFE: The Contractor shall, at all times, perform all work and take such steps required to prevent any interference or disturbance to wildlife. The Contractor shall not be permitted to alter water flows or otherwise disturb native habitat adjacent to the project area. Fouling or polluting of water shall not be allowed.

1.12 ARCHAEOLOGICAL AND HISTORICAL ARTIFACTS: Any archaeological or historical artifacts which are encountered during the course of construction shall remain the property of the Government. If archaeological or historical items and/or remains are encountered, the Contractor shall stop all work immediately and will notify the COR.

1.13 MAINTENANCE OF POLLUTION CONTROL FACILITIES DURING CONSTRUCTION: During the duration of this contract, the Contractor shall maintain all facilities for pollution control under this contract as long as the operations creating the particular pollutant are being carried out or until the material concerned has become stabilized to the extent that pollution is no longer being created. The Contractor will maintain on site, in a readily accessible manner, an indexed loose-leaf binder containing a copy of the Material Safety Data Sheets (MSDS) for each chemical and chemical containing material used on the job site.

1.14 QUALITY CONTROL: The Contractor shall establish and maintain quality control to assure compliance with contract requirements and shall maintain records of his quality control for all construction operations required under this section and section *Contractor Quality Control*.

PART 2- PRODUCTS - NOT USED

PART 3 – EXECUTION- NOT USED

END OF SECTION

SECTION 01200 - PROJECT MEETINGS

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 specifies administrative and procedural requirements for project meetings, including, but not limited to, the following:

1. Preconstruction conferences.
2. Preinstallation conferences.
3. Progress meetings.
4. Coordination meetings.

1.3 PRECONSTRUCTION CONFERENCE

A. Schedule a preconstruction conference before starting construction, at a time convenient to the Contracting Officer and the Contracting Officer's Representative, but no later than 30 days after Notice to Proceed. Hold the conference at the Project Site or another convenient location within NIMA's facilities. Conduct the meeting to review responsibilities and personnel assignments.

B. Attendees: Authorized representatives of the Government, Contracting Officer, Contracting Officer's Representative, and their consultants; the Contractor and its superintendent; major subcontractors; manufacturers; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with the Project and authorized to conclude matters relating to the Work.

C. Agenda: Discuss items of significance that could affect progress, including the following:

1. Tentative construction schedule.
2. Critical work sequencing.
3. Designation of responsible personnel.
4. Procedures for processing field decisions and Change Orders.
5. Procedures for processing Applications for Payment.
6. Distribution of Contract Documents.
7. Submittal of Shop Drawings, Product Data, and Samples.
8. Preparation of record documents.

9. Use of the premises.

10. Parking availability.

11. Office, work, and storage areas.

12. Equipment deliveries and priorities.

13. Safety procedures.

14. First aid.

15. Security.

16. Housekeeping.

17. Working hours.

1.4 PREINSTALLATION CONFERENCES

A. Conduct a preinstallation conference at the Project Site before each construction activity that requires coordination with other construction.

B. Attendees: The 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 the Contracting Officer of scheduled meeting dates.

1. Review the progress of other construction activities and preparations for the particular activity under consideration at each preinstallation conference, including requirements for the following:

a. Contract Documents.

b. Options.

c. Related Change Orders.

d. Purchases.

e. Deliveries.

f. Shop Drawings, Product Data, and quality-control samples.

g. Review of mockups.

h. Possible conflicts.

i. Compatibility problems.

j. Time schedules.

k. Weather limitations.

l. Manufacturer's recommendations.

m. Warranty requirements.

n. Compatibility of materials.

o. Acceptability of substrates.

p. Temporary facilities.

q. Space and access limitations.

r. Governing regulations.

s. Safety.

t. Inspecting and testing requirements.

u. Required performance results.

v. Recording requirements.

w. Protection.

2. Record significant discussions and agreements and disagreements of each conference, and the approved schedule. Promptly distribute the record of the meeting to everyone concerned, including the Contracting Officer and the Contracting Officer's Representative.

3. Do not proceed with the installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of Work and reconvene the conference at the earliest feasible date.

1.5 PROGRESS MEETINGS

A. Conduct progress meetings at the Project Site at regular intervals. Notify the Contracting Officer and the Contracting Officer's Representative of scheduled meeting dates. Coordinate dates of meetings with preparation of the payment request.

B. Attendees: In addition to representatives of the Government, each subcontractor, supplier, or other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with the Project and authorized to conclude matters relating to the Work.

C. Agenda: Review and correct or approve minutes of the previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to the status of the Project.

1. Contractor's Construction Schedule: Review progress since the last meeting. Determine where each activity is in relation to the Contractor's Construction Schedule, whether on time or ahead or behind schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule

revisions are required to insure that current and subsequent activities will be completed within the Contract Time.

2. Review the present and future needs of each entity present, including the following:

   a. Interface requirements.

   b. Time.

   c. Sequences.

   d. Status of submittals.

   e. Deliveries.

   f. Off-site fabrication problems.

   g. Access.

   h. Site utilization.

   i. Temporary facilities and services.

   j. Hours of work.

   k. Hazards and risks.

   l. Housekeeping.

   m. Quality and work standards.

   n. Change Orders.

   o. Documentation of information for payment requests.

D. Reporting: No later than 3 days after each meeting, distribute minutes of the meeting to each party present and to parties who should have been present. Include a brief summary, in narrative form, of progress since the previous meeting and report.

   1. Schedule Updating: Revise the Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue the revised schedule concurrently with the report of each meeting.

1.6 COORDINATION MEETINGS

A. Conduct project coordination meetings at regular intervals convenient for all parties involved. Project coordination meetings are in addition to specific meetings held for other purposes, such as regular progress meetings and special preinstallation meetings.

B. Request representation at each meeting by every party currently involved in coordination or planning for the construction activities involved.

C. Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01200

SECTION 01315 - CPM SCHEDULES

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 administrative and procedural requirements for the critical path method (CPM) of scheduling and reporting progress of the Work.

1. Refer to the General Conditions and the Agreement for definitions and specific dates of Contract Time.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 1 Section "Submittals" specifies requirements for submitting the Construction Schedule.

2. Division 1 Section "Project Meetings" specifies requirements for submitting and distributing meeting and conference minutes.

3. Division 1 Section Contractor "Quality Control" specifies requirements for submitting inspection and test reports.

1.3 DEFINITIONS

A. Critical Path Method (CPM): A method of planning and scheduling a construction project where activities are arranged based on activity relationships and network calculations determine when activities can be performed and the critical path of the Project.

B. Critical Path: The longest continuous chain of activities through the network schedule that establishes the minimum overall project duration.

C. Network Diagram: A graphic diagram of a network schedule, showing the activities and activity relationships.

D. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

1. Critical activities are activities on the critical path.

2. Predecessor activity is an activity that must be completed before a given activity can be started.

E. Event: An event is the starting or ending point of an activity.

F. Milestone: A key or critical point in time for reference or measurement.

G. Float is the measure of leeway in activity performance. Accumulative float time belongs to the Government.

1. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the following activity.

2. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned project completion date.

1.4 CPM SCHEDULE

A. Prepare the Contractor's Construction Schedule using the network analysis diagram system known as the critical path method (CPM).

1. Proceed with preparation of the network diagram immediately following notification of Contract award.

2. Follow the steps necessary to complete development of the network diagram in sufficient time to submit the CPM Schedule so it can be accepted for use no later than 30 days after Notice to Proceed.

The Construction Schedule shall be a computer generated time-scaled precedence network diagram using the Critical Path Method (CPM). Primavera Project Planner Version 1.1 for Windows is pre-approved for use on this project. All Construction Schedule submissions and updates shall be made in a plotted paper format (minimum "E" size drawing paper) and on 3.5" floppy diskettes containing all schedule files.

3. Construction Schedule Requirements: The Construction Schedule shall be a time-scaled precedence network diagram graphically depicting the sequence proposed to accomplish each work activity, operation, major submittal process, utility shutoff, and similarly significant events. Interdependencies between the various activities shall be clearly indicated. The title, cost, duration, and starting and completion dates of each activity shall be provided legibly on the Construction Schedule. All critical work activities shall be clearly indicated. Key dates for important features or portions of work features, such as initiation or completion of a project phase and milestone dates, shall be so indicated on the Construction Schedule. An earnings-time curve ("S" curve) showing the rate of construction progress in terms of dollars and percent completion shall be super-imposed on the Construction Schedule. For the purpose of determining the "S" curve, the cost of material and equipment shall be incorporated at the scheduled installation time, and not the on-site delivery date. This Construction Schedule shall be the medium through which the timeliness of the Contractor's construction effort is appraised.

4. Construction Schedule Updating: The Contractor shall update the schedule by entering actual progress at monthly intervals and submit this update with the payment application. Specific areas where progress is behind schedule shall be identified in the progress report. The status of activities completed or partially completed at the end of each period shall be shown, as well as the percentages of work completed. In computing actual progress, the value of material and equipment on site, but not incorporated into the work, may not be considered. When changes are authorized that result in contract time extensions, the Contractor shall submit a modified Construction Schedule for approval by the COR. The contract clause entitled "Schedules for Construction Contract" with reference to overtime, extra shifts, etc., may be invoked when the Contractor fails to start or complete work activities or portions of same by the dates indicated on the approved Construction Schedule, or when it is apparent to the COR from the Contractor's actual progress that these dates will not be met.

B. CPM Schedule Preparation: Prepare a list of all activities involved in the Project. Include a list of activities required to complete the Work. Provide the best data available for generation of the network diagram and the CPM Schedule.

1. Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities.

2. Indicate estimated times for the following activities to be performed:

a. Preparation and processing of submittals.
b. Purchase of materials.
c. Delivery.
d. Fabrication.
e. Installation.

3. Treat each story or separate area as a separate numbered activity for principal elements of the Work.

4. Using the preliminary network diagram, prepare a skeleton network to identify probable critical paths.

C. Processing: Enter prepared data on the processing system. Process data to produce output data or a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM Schedule within the limitations of Contract Time.

D. Format: Display the full network on a single sheet of stable transparency, or other reproducible media, of sufficient width to show data clearly for the entire construction period.

1. Mark the critical path. Locate the critical path near the center of the network; locate paths with the most float near the edges.

2. Subnetworks on separate sheets are permissible for activities clearly off the critical path.

E. Initial Issue: Prepare the initial issue of the CPM Schedule network diagram from a listing of straight "early start-total float" sort. Identify critical activities. Prepare tabulated reports to show the following:

1. The Contractor or subcontractor and Work or activity.
2. Description of the activity.
3. Principal events of that activity.
4. Immediate preceding and succeeding activities.
5. Early and late start dates.
6. Early and late finish dates.
7. Activity duration in working days.
8. Total float or slack time.
9. Average size of workforce.
10. Dollar value of activity (coordinated with the Schedule of Values).

F. Value Summaries: Prepare 2 cumulative value listings, sorted by finish dates.

1. In first listing, tabulate the following:

a. Activity number.
b. Early finish date.
c. Dollar value.
d. Cumulative dollar value.

2. In second listing, tabulate the following:

a. Activity number.
b. Late finish date.
c. Dollar value.
d. Cumulative value.

3. In subsequent issues of both listings, substitute actual finish dates for activities completed as of listing date.

G. Prepare listing for ease of comparison with payment requests; coordinate timing with progress meetings.

1. In both value summary listings, tabulate "actual percent complete," and "cumulative value completed" with total at bottom.

2. Submit value summary printouts following each regularly scheduled progress meeting.

1.5 SUBMITTALS

A. Submittal and Distribution: Submit 3 copies of the initial issue of the tabulations and network for acceptance. When authorized, distribute copies to the Contracting Officer, the Government, separate contractors, subcontractors and suppliers or fabricators, and others identified by the Contractor with a need-to-know schedule responsibility.

1. Post copies in the temporary field office.

2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

3. Submit copies of each computer-produced report to the Contracting Officer.

B. Schedule Updating: Revise the schedule immediately after each meeting or other activity, where revisions have been recognized or made. Issue the updated schedule concurrently with the report of each project meeting.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01315

SECTION 02000 - GEOTECHNICAL ENGINEERING REPORT

PART 1 - GENERAL

1.1 SUBSURFACE EXPLORATION DATA

A Geotechnical engineering report has been prepared for this project by ECS, Ltd. This report is provided for informational purposes only and shall not be considered part of the contract documents. The opinions expressed in this report are those of the geotechnical engineer and represent his interpretation of the subsurface conditions, tests, and the results of analyses which he has conducted. Should the data contained in this report not be adequate for the contractor's purposes, the Contractor may make his own exploration, tests and analyses prior to building. Contractors desiring to examine the site shall contact the COTR for arrangements to enter the project site.

Availability of Data: The above referenced report is reproduced hereafter. Field logs and laboratory data sheets are available only at the office of the Geotechnical engineer and will be available only at his discretion.

Engineering Consulting Services, Ltd.

5103 Pegasus Court, Suite K

Frederick, MD 21704

Tel. (301) 668-4304

PART 2-PRODUCTS

Not applicable.

PART 3 – EXECUTION

Not applicable.

END OF SECTION

Report of Subsurface Exploration and
Geotechnical Engineering Analysis

PROJECT

Pedestrian Bridge
NIMA Freemont Building
Bethesda, Maryland

CLIENT

Mr. Jim Heltman
Alphatec, P.C.
1525 18th Street, NW
Washington, DC 20036

Submitted By
Engineering Consulting Services, Ltd.
5103 Pegasus Court
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Frederick, Maryland 21704

PROJECT 13-1424

DATE May 16, 2002

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PROJECT OVERVIEW

Project Location and Proposed Construction

The subject site is located on the campus of the National Imagery & Mapping Agency at 6100 MacArthur Boulevard in Bethesda, Maryland. The site is currently occupied by a parking lot, roadway and grass area. A Site Vicinity Map included in the Appendix of this report shows the approximate location of this project.

Based on a current site plan provided to us, we understand that the project will include the construction of a pedestrian bridge connecting the existing asphalt parking lot to the Freemont Building. The bridge will be supported on four piers. Bridge loads provided to us by Alphatec, Inc. indicate bridge pier loads of 57,000 lbs. to 155,000 lbs.

Scope of Work

The recommendations contained in this report are based on our field subsurface explorations and the review of available geologic and/or geotechnical data. The subsurface exploration program included a total of three soil borings, extended to depths of 28.6 to 38.5 feet. Visual tests were then performed on all soil samples to classify the soils and to assist in determination of the properties of the on-site soils. We have also visited the site recently to conduct a site reconnaissance of current conditions.

The boring locations for the proposed project were selected and located in the field by Alphatec, Inc. The ground surface elevations, noted on the boring logs, were provided to us. The Boring Location Plan in the Appendix indicates the approximate physical location of the borings performed at the site under the direction of ECS, Ltd.

Purposes of Exploration

The purposes of the exploration were to explore the soil and ground water conditions at the site and to develop engineering recommendations to guide the final design and construction of the geotechnical aspects of the proposed project. We accomplished these purposes by:

1. drilling borings to explore the subsurface soil and ground water conditions,
2. performing visual laboratory tests on soil samples recovered from the test borings to evaluate pertinent engineering properties and,
3. evaluating the field and laboratory test results to develop appropriate geotechnical engineering recommendations.

EXPLORATION PROCEDURES

Subsurface Exploration Procedures

The soil borings were performed with truck-mounted auger drilling rig, which utilized continuous flight, hollow stem augers to advance the boreholes. Drilling fluid was not used in this process.

Representative soil samples were obtained by means of the split-barrel sampling procedure in accordance with ASTM D-1586. In this procedure, a 2-inch O.D., split-barrel sampler is driven into the soil a distance of 18 inches by a 140-pound hammer falling 30 inches. The number of blows required to drive the sampler through the final 12-inch interval is termed the Standard Penetration Test (SPT) value, or "N" value, and is indicated for each sample on the boring logs. This value can be used as a qualitative indication of the in-place relative density of noncohesive soils. In a less reliable way, it also indicates the consistency of cohesive soils. This indication is qualitative, since many factors can significantly affect the standard penetration resistance value and prevent a direct correlation between drill crews, drill rigs, drilling procedures, and hammer-rod-sampler assemblies.

A field log of the soils encountered in the borings was maintained by the drill crew. After recovery, each sample was removed from the sampler and visually classified. Representative portions of each sample were then sealed and brought to our laboratory for further visual examination and laboratory testing.

Soil Classification

An experienced soil engineer classified each soil sample on the basis of texture and plasticity in accordance with the Unified Soil Classification System (USCS). The group symbols for each soil type are indicated in parentheses following the soil descriptions on the boring logs. A brief explanation of the Unified System is included with this report. The soil engineer grouped the various soil types into the major zones noted on the boring logs. The stratification lines designating the interfaces between earth materials on the boring logs are approximate; in situ the transitions may be gradual.

EXPLORATION RESULTS

Current Site Conditions

A site visit was conducted by an engineer from ECS, Ltd. in March 2002 to observe existing site conditions. The site area of the proposed pedestrian bridge will pass from an existing parking lot, over grass and roadway area, and connect to the existing Freemont Building. Existing grades in the areas of the proposed bridge vary from about El 208 at the existing parking lot to about El 184 on the south end of the proposed bridge.

Regional Geology

The project site is located in the upland section of the Piedmont Plateau Physiographic Province. The bedrock geology underlying the project site was identified on the Geologic Map of Maryland, 1968, as Boulder Gneiss of the Wissahickon Formation of Lake Precambrian Geologic age. The virgin soils encountered in this area are the residual product of in-place chemical weathering of the rock presently underlying the site. The typical residual soil profile consists of silty to clayey soils near the surface where soil weathering is more advanced, underlain by more sandy silts and silty sands that generally become harder and more dense with depth to the top of parent bedrock. The boundary between soil and rock, termed weathered or decomposed rock, is not sharply defined. This transitional zone can contain boulders of more resistant rock as well as highly weathered materials. Materials labeled as "Decomposed Rock" on the boring logs exhibit the remnant structure of the underlying parent bedrock.

Soil Conditions

To evaluate the subsurface conditions within the project area, three soil test borings (B-1 to B-3) were drilled to depths of 28.6 to 38.5 feet below the existing ground surface. The approximate boring locations are presented on the enclosed Boring Location Plan. Ground surface elevations were provided to us by Alphatec, Inc.

In general, the subsurface conditions encountered during our field exploration consisted of a surficial layer of topsoil or asphalt, overlying existing fill in borings B-1 and B-3, and natural residual soils in the remaining test boring. A brief description of the soils encountered is presented in the following paragraphs. More detailed descriptions are provided on the boring logs contained in the Appendix.

Existing fill materials were encountered in borings B-1 and B-3 to depths of about 5.0 to 18.5 feet below existing grades. The existing fill materials encountered in the soil test borings were classified as Sandy SILT (ML) and Silty SAND (SM). The fill materials are believed to be the result of previous site grading. The density of the existing fill material was generally considered very loose to firm with standard penetration test (SPT) blow counts of 2 to 10 blows per foot

(bpf). The fill materials were colored light to dark brown with the moisture contents characterized as moist.

Natural residual soils were encountered below the existing fill in borings B-1 and B-3, and below the surface layer of topsoil in boring B-2. The natural residual soils encountered to depths of 13.5 to 23.5 feet in the soil borings generally consisted of Sandy SILT (ML) and Silty SAND (SM). Measured SPT values in the test borings ranged from 6 to 41 blows per foot (bpf) indicating medium dense soils. The color of these residual materials ranged from loose to yellowish brown to light brown and the moisture contents in these soils were characterized as moist.

Below the residual soils in the borings, extremely dense materials with a blow count greater than 60 have been noted on the borings logs as decomposed rock. The decomposed rock extended to depths of 28.6 to 38.5 feet. These materials exhibit rock like qualities and depending on various perimeters may be extremely difficult to excavate, and may require rock excavation methods for removal. The residual materials were generally observed to increase in density with depth across the project site.

Ground Water Observations

Observations for ground water were made during sampling and upon completion of the drilling operations at each boring location. In auger drilling, water is not introduced into the boreholes and the ground water position can often be estimated by observing water levels in the boreholes. Furthermore, visual examination of the soil samples retrieved during the auger drilling can often be used in evaluating the ground water conditions.

Ground water was not observed in any of the borings during drilling, or to the depth at which the borings caved at 22.5 to 29.5 feet. Considering the depth of excavation required to achieve the assumed foundation subgrade elevations, the ground water table is not expected to be a significant factor during design and construction. Perched water, surface water runoff, and flow across the site may be a factor, and steps should be taken during construction to control surface water runoff and to remove any water that may accumulate in the excavations. If encountered in excavations, the contractor should be prepared to dewater the excavations.

The highest ground water observations are normally encountered in late winter and early spring. Our borings were performed in late winter, after a period of relatively dry summer, fall, and winter weather, and did not indicate the presence of ground water. Variations in the location of the long-term water table may occur as a result of changes in precipitation, evaporation, surface water runoff, and other factors not immediately apparent at the time of this exploration. Free water may also be encountered at the interface of fill materials and natural soils.

ANALYSES AND RECOMMENDATIONS

The recommendations presented in this report are based on the project information provided to us, the results of the soil test borings and our engineering analyses. The test borings indicate that natural sand and silt soils may be expected at shallow depths in the areas of borings B-2 and B-3; however, generally loose existing fill soils extend to 18.5 feet depth in the area of boring B-1. Spread footings founded on the natural soils are considered suitable for support of bridge Piers A, B, and C. In the area of boring B-1, performed near bridge Pier D, due to the deep existing fill soils, spread footings will not be feasible. For Pier D, we recommend supporting the pier on drilled pier foundations bearing on the underlying decomposed rock. Our recommendations are detailed below.

Spread Footing Foundations

Spread footing foundations are recommended for support of Piers A, B, and C. Due to the variable density of the natural soils at the boring and pier locations, we believe using multiple allowable bearing pressures for the piers will provide the most economical foundation systems. The following table provides recommended bearing pressures at each pier:

Pier	Nearest Boring No.	Maximum Net Allowable Soil Bearing Pressure (psf)	Estimated Highest Elevation for Recommended Bearing Pressure
A	3	3,000	EL 179
B	3	3,000	EL 179
C	2	5,000	EL 187

The net allowable soil bearing pressure refers to that pressure which may be transmitted to the foundation bearing soils in excess of the final minimum surrounding overburden pressure. If a uniform soil bearing pressure is desired, we recommend a maximum soil bearing pressure of 3,000 psf be used.

It should be noted that Pier A will be adjacent to the existing building. Depending on the construction methods used to excavate for the Freemont Building, backfill soils against the below grade walls may be encountered at the pier foundation subgrade. If unsuitable fill soils are encountered at footing subgrade, the soils should be removed and replaced with new compacted fill or foundations lowered to natural soils. Foundation founded on new compacted structural fill may be proportioned for an allowable soil bearing pressure of 3,000 psf.

Settlement of individual footings founded on the natural soils or new compacted structural fill are expected to be small and within tolerable limits for the proposed structure. Total settlements on the order of one inch or less are expected, with differential settlement between any two adjacent foundations to be on the order of 1/2 inch or less.

To help reduce the possibility of foundation bearing failure and excessive settlement due to local shear or "punching" action, foundations should have a minimum lateral dimension of 2.5 feet. In addition, footings should be placed at a depth to provide adequate frost cover protection. Therefore, we recommend that footings be placed at a minimum depth of 2.5 feet below finished grade.

Drilled Pier

Boring B-1, performed in the vicinity of Pier D, indicates that loose existing fill soils extend to a depth of 18.5 feet, or to EL 189.5. These soils are not considered suitable for support of Pier D. We recommend that Pier D be founded on a drilled pier foundation. Considering the relatively light load at Pier D, our analysis indicates that an allowable end bearing pressure of 10 tsf can be used for design of a straight-shaft pier bearing on the decomposed rock material encountered in boring B-1 at about EL 184. We recommend a minimum drilled pier shaft diameter of 30 inches in order to allow access for inspection and cleaning. The actual suitability of the bearing soils should be evaluated by the geotechnical engineer during construction.

Our analysis indicates that total settlement of less than about 1 inch is expected for the drilled pier.

Earthwork Operations

If any engineered fill for support of footings is required, the fill should consist of soils classified as ML, SM, SC or more granular per ASTM D-2487, and having a liquid limit less than 45 and plasticity index less than 20.

All structural fill should be placed in loose lifts, which do not exceed 8 inches in thickness, and should be compacted to at least 95 percent of the maximum dry density, as determined by the Standard Proctor Compaction Test (ASTM D-698). Generally, the moisture content of the fill materials should be maintained within ±2 percent of the optimum moisture content for the fill material, as determined by ASTM D-698. Fill placed in non-structural areas (e.g. grassed areas) should be compacted to at least 90 percent of the maximum dry density according to ASTM D-698, in order to avoid significant subsidence.

Excavation Slopes and Support

For temporary cuts or excavations, side slopes as steep as 1H:1V are possible in the natural soils observed at this site. For long-term stability, side slopes generally should be no steeper than 3H:1V in either natural soils or fill soils. All temporary and permanent slopes should be aggressively protected, such as by seeding and mulching as soon as possible after placement, to prevent from sloughing and erosion.

The contractor should avoid stockpiling excavated materials or equipment immediately adjacent to the excavation walls. We recommend that stockpiled materials be kept back from the excavation a minimum distance equal to 1/2 the excavation depth to limit surcharging the excavation walls. If this is impractical due to space constraints, the excavation walls should be retained with bracing designed for the anticipated surcharge load. All excavations should be performed in accordance with OSHA guidelines.

Construction Considerations

Precautionary measures should be taken to ensure that preparation of footing bearing surfaces are accomplished by the recommended procedures. These precautions are necessary, as the silt materials observed in our borings are disturbance sensitive, and will become weakened if water intrudes into the footing excavations. Therefore, we recommend that all excavations be properly dewatered, if necessary, using conventional sump pit and pumping operations. The site should be graded such that surface water runoff is directed away from the excavations.

Exposure to the environment may weaken the soils at the footing bearing level if the foundation excavations remain open for too long a time. Therefore, foundation concrete should be placed the same day that excavations are completed. If the bearing soils are softened by surface water intrusion or exposure, the softened soils must be removed from the foundation excavation bottom immediately prior to placement of concrete. If the excavation must remain open overnight, or if rainfall becomes imminent while the bearing soils are exposed, we recommend that a 1-to 3-inch thick "mud-mat" of "lean" concrete be placed on the bearing soils before the placement of reinforcing steel.

Closing

This report has been prepared to aid in the evaluation of this site and to assist the Design Team with the design of the proposed bridge. The report scope is limited to this specific project and the location described. The project description represents our current understanding of the significant aspects of the proposed improvements relevant to the geotechnical considerations.

We have appreciated the opportunity to be of service to Alphatec, Inc. and look forward to continuing our involvement on the project during the construction phases.

APPENDIX

Site Vicinity Map

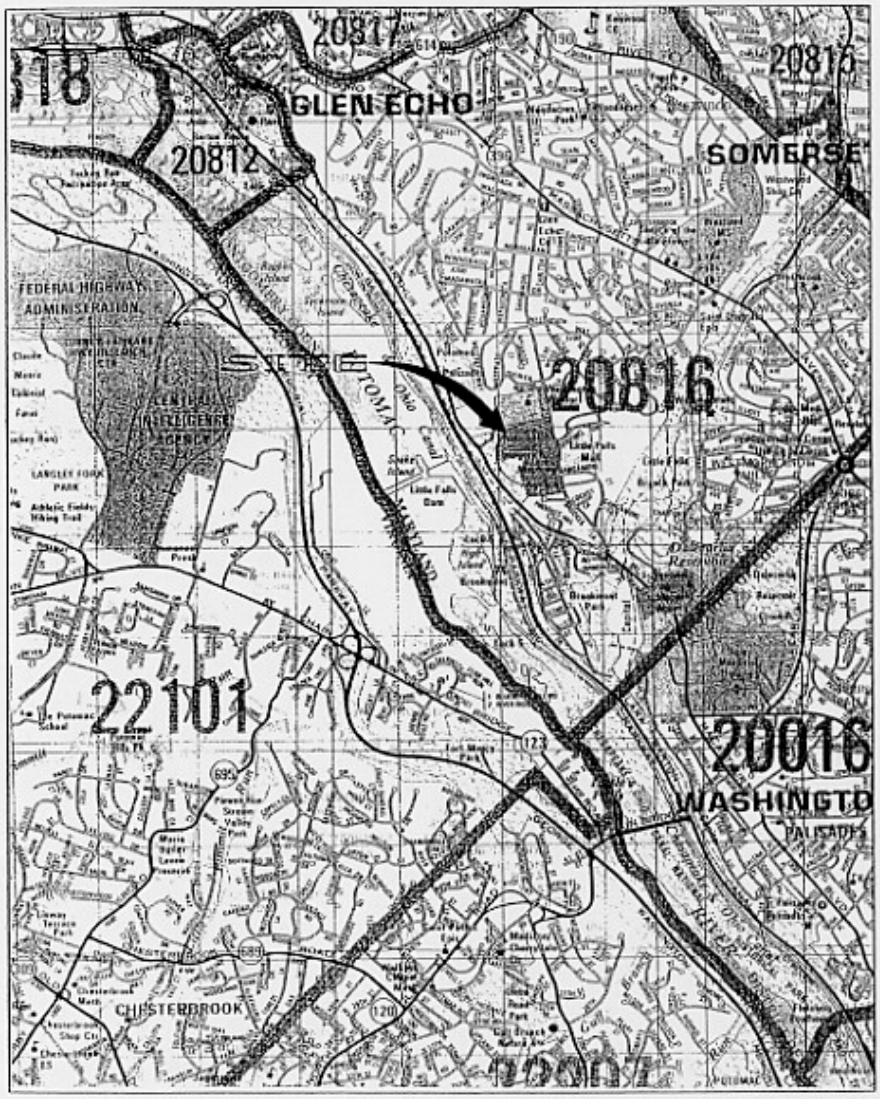
Unified Soil Classification System

Soil Laboratory Test Results

Reference Notes For Boring Logs

Boring Logs B-1 through B-3

Boring Location Plan



NIMA
6100 MACARTHUR BLVD

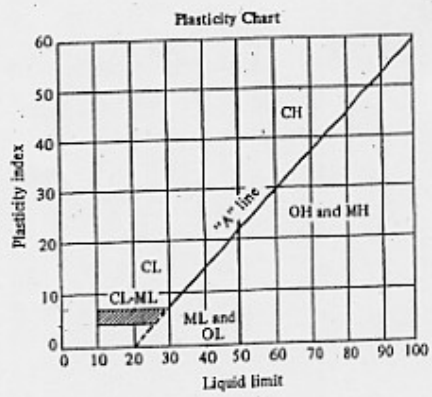
ECS LTD
ENGINEERING
CONSULTING
SERVICES, LTD

FIG. 1: SITE VICINITY MAP

SCALE: 1"=2000'
ECS PROJ. #: 13-1424

Unified Soil Classification System (ASTM D-2487)

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



[a]Division of GM and SM groups into subdivisions of d and u are for roads and airfields only. Subdivision is based on Atterberg limits; suffix d used when L.L. is 28 or less and the P.I. is 6 or less; the suffix u used when L.L. is greater than 28.
[b]Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC, well-graded gravel-sand mixture with clay binder.

From Winterkorn and Fang, 1975

Engineering Consulting Services, Ltd.
Frederick, Maryland
Laboratory Testing Summary

Date: 3/22/02

Project Number: 13-1424 **Project Name: Nima-Freemont Building**

Project Engineer: 0 **Principal Engineer: SVF** **Summary By: KPK**

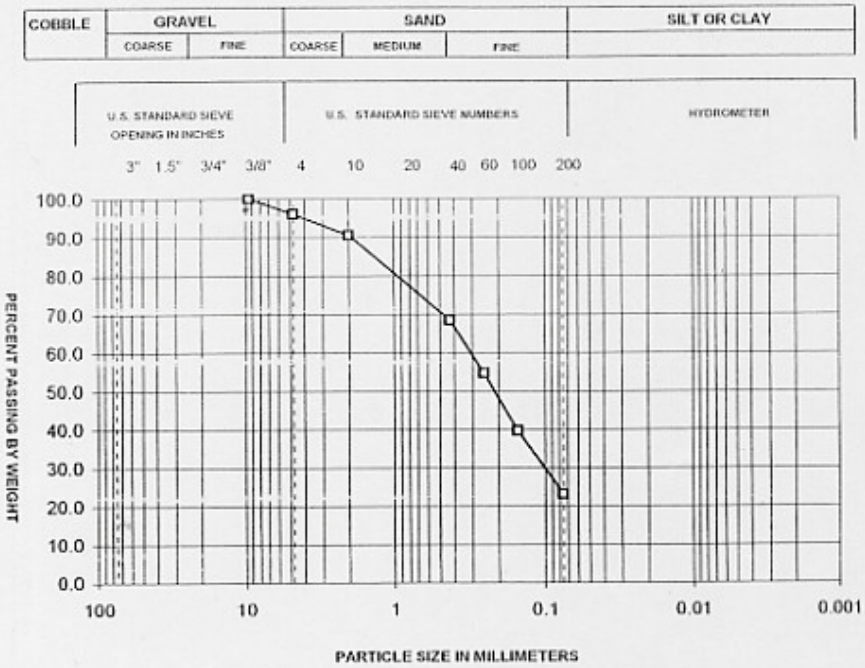
Boring Number	Sample Number	Depth	Moisture Content (%)	Soil Description	LL	PL	PI	Percent Passing No. 200 Sieve	Maximum Dry Density (pcf)	Optimum Moisture Content (%)	CBR *	Other
B-1	S-1	1-2.5	18.0	Silty SAND (ML) Light Brown								
B-1	S-2	2.5-4.0	13.3	Sandy SILT (ML/FILL), Light Brown								
B-1	S-3	5.0-6.5	9.8	Sandy SILT (ML/FILL), Light Brown								
B-1	S-4	8.5-10.0	8.2	Sandy SILT (ML), Light Brown								
B-2	S1	1.0-2.5	7.9	Silty SAND (ML) Light Brown	22	NP	NP	23.2				

Summary Key:
SA = See Attached
S = Standard Proctor
M= Modified Proctor
V = Virginia Test Method
OC = Organic Content

LL= Liquid Limit
PL= Plastic Limit
PI= Plasticity Index

Hyd = Hydrometer
Con = Consolidation
DS = Direct Shear
GS = Specific Gravity

UCS = Unconfined Compression Soil
UCR = Unconfined Compression Rock
LS = Lime Stabilization
CS = Cement Stabilization



BORING/ SAMPLE	DEPTH (FEET)	SYMBOL	LL	PI	DESCRIPTION
B-2 / S1	1.0-2.5	□	22	NP	Silty SAND (ML) Light Brown
/		■			
/		△			
/		▲			

Project: Nima-Freemont Building

Project No.: 13-1424

Date: 3/22/02

Engineering Consulting Services, Ltd

Frederick, Maryland

Grain Size Analysis

REFERENCE NOTES FOR BORING LOGS

I. Drilling Sampling Symbols:

SS	Split Spoon Sampler	ST	Shelby Tube Sampler
RC	Rock Core, NX, BX, AX	PM	Pressuremeter
DC	Dutch Cone Penetrometer	RD	Rock Bit Drilling
BS	Bulk Sample of Cuttings	PA	Power Auger (no sample)
HAS	Hollow-Stem Auger	WS	Wash Sample

II. Correlation of Penetration Resistances to Soil Properties:

Standard Penetration (Blows/Ft) refers to the blows per foot of a 140 lb. Hammer falling 30 inches on a 2-inch OD split spoon sampler, as specified in ASTM D-1586. The blow count is commonly referred to as the N value.

A. Non-Cohesive Soils (Silt, Sand, Gravel and Combinations)

Density		*Relative Properties*	
Under 3 blows/ft.	Very Loose	Adjective Form	36% to 49%
4 to 6 blows/ft.	Loose	With	21% to 35%
7 to 10 blows/ft.	Firm	Some	11% to 20%
11 to 30 blows/ft.	Medium Dense	Trace	1% to 10%
31 to 50 blows/ft.	Dense		
51 to 80 blows/ft.	Very Dense		
Over 80 blows/ft.	Extremely Dense		

Particle Size Identification

Boulders		8 inches or larger
Cobbles		3 to 8 inches
Gravel	Coarse	1 to 3 inches
	Medium	½ to 1 inch
	Fine	¼ to ½ inch
Sand	Coarse	2.00mm to ¼ inch (dia. of lead pencil)
	Medium	0.42 to 2.00mm (dia. of broom straw)
	Fine	0.074 to 0.42mm (dia. of human hair)
Silt and Clay		0 .0 to 0.074mm (particles cannot be seen)

B. Cohesive Soils (Clay, Silt, and Combinations)

Blows/Ft	*Consistency*	*Unconfined Comp. Strength Q_P(tsf)*	*Degree of Plasticity*	*Plasticity Index*
Under 4	Very Soft	Under 0.25	None to Slight	0 - 4
4 to 5	Soft	0.25-0.49	Slight	5 – 7
6 to 10	Med. Stiff	0.50-0.99	Medium	8- 22
11 to 15	Stiff	1.00-1.99	High to Very High	Over 22
16 to 30	Very Stiff	2.00-3.00		
31 to 50	Hard	4.00-8.00		
Over 51	Very Hard	Over 8.00		

III. Water Level Measurement Symbols

WL	Water Level	BCR	Before Casing Removal
WS	While Sampling	ACR	After Casing Removal
WD	While Drilling	WCI	Wet Cave-In
		DCI	Dry Cave-In

The water levels are those water levels actually measured in the borehole at the times indicated by the symbol. The measurements are relatively reliable when augering, without adding fluids, in a granular soil. In clay and plastic silts, the accurate determination of water levels may require several days for the water level to stabilize. In such cases, additional methods of measurement are generally applied.

CLIENT	JOB #	BORING #	SHEET
Alphatec, P.C.	13-1424	B-1	1 OF 2

ECS LTD

PROJECT NAME: NIMA

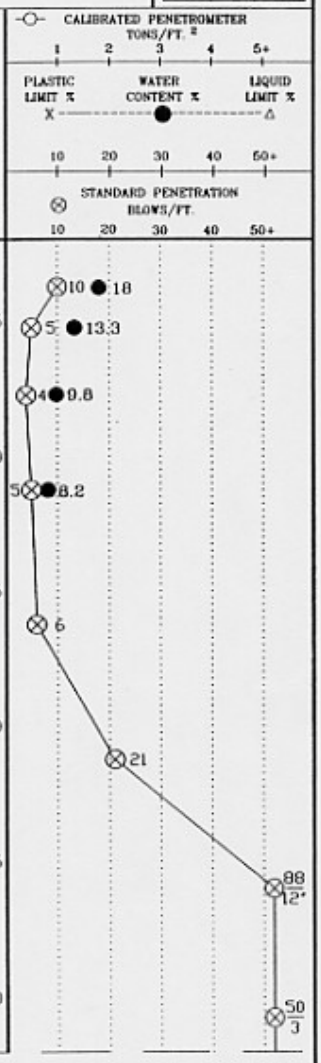
ARCHITECT-ENGINEER:

SITE LOCATION: 6100 MacArthur Blvd

ENGLISH UNITS

SURFACE ELEVATION: 208.00

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)
0					Asphalt		
	1	SS	18	18	Sandy SILT, Some Rock Fragments, Medium Brown, Moist, Firm, (ML,FILL)		
	2	SS	18	18	Sandy SILT, Light Brown, Moist, Loose, (ML, FILL)		205
5	3	SS	18	18	Sandy SILT, Some Rock Fragments, Light Brown, Moist, Loose, (ML, FILL)		200
10	4	SS	18	18	Silty SAND, Light Brown, Moist, Loose, (SM, FILL)		195
15	5	SS	18	18	Silty SAND, Medium Brown, Moist, Loose, (SM, FILL)		190
20	6	SS	18	18	Sandy SILT, Yellowish Brown, Moist, Medium Dense, (ML)		185
25	7	SS	12	12	Decomposed Rock, Light Brown Moist, Very Dense		180
30	8	SS	3	3			



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THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

WL DRY WS OR WD	BORING STARTED 3-16-02	ASPHALT DEPTH 6"
WL(AB) WL(AC)	BORING COMPLETED 3-16-02	CAVE IN DEPTH @ 29.5
WL	RIG CME 45B FOREMAN CONNELLY	DRILLING METHOD HSA

CLIENT	JOB #	BORING #	SHEET
Alphatec, P.C.	13-1424	B-1	2 OF 2
PROJECT NAME: NIMA	ARCHITECT-ENGINEER		

ECS LTD

SITE LOCATION: 6100 MacArthur Blvd

CALIBRATED PENETROMETER TONS/FT.² (1, 2, 3, 4, 5+)

PLASTIC LIMIT % X — WATER CONTENT % ● — LIQUID LIMIT % △ (10, 20, 30, 40, 50+)

STANDARD PENETRATION BLOWS/FT. ⊗ (10, 20, 30, 40, 50+)

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	STANDARD PENETRATION BLOWS/FT.
					ENGLISH UNITS			
					SURFACE ELEVATION 208.00			
							175	
	9	SS	5	5				55/5
							170	
	10	SS	0	0				50/0
					AUGER REFUSAL @ 38.5'			
							165	
							160	
							155	
							150	

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

WL DRY — WS OR WD	BORING STARTED 3-16-02	ASPHALT DEPTH 6"
WL(AB) WL(AC)	BORING COMPLETED 3-16-02	CAVE IN DEPTH @ 29.5
WL	RIG CME 45B FOREMAN CONNELLY	DRILLING METHOD HSA

CLIENT	JOB #	BORING #	SHEET
Alphatec, P.C.	13-1424	B-2	1 OF 1
PROJECT NAME: NIMA	ARCHITECT-ENGINEER		

SITE LOCATION: 6100 MacArthur Blvd

ECS LTD

-O- CALIBRATED PENETROMETER TONS/FT.² (1, 2, 3, 4, 5+)

PLASTIC LIMIT % X — WATER CONTENT % ● — LIQUID LIMIT % △

⊗ STANDARD PENETRATION BLOWS/FT. (10, 20, 30, 40, 50+)

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL (ENGLISH UNITS)	ELEVATION (FT)	CALIBRATED PENETROMETER (TONS/FT.²)	STANDARD PENETRATION (BLOWS/FT.)
0					Asphalt, Concrete			
	1	SS	18	18	Silty SAND, With Rock Fragments, Light Brown, Moist, Medium Dense, (SM)		7.9	28
	2	SS	10	8		185		50/4"
					Decomposed Rock, Light Brown, Moist, Extremely Dense			
5	3	SS	18	18	Silty SAND, With Rock Fragments, Light Brown, Moist, Medium Dense, (SM)			22
						180		
	4	SS	18	18				41
10								
						175		
	5	SS	18	18	Decomposed Rock, Light Brown, Moist, Very Dense			72
15								
						170		
	6	SS	6	5	Decomposed Rock, Light Brown, Moist, Extremely Dense			50/6"
20								
						165		
	7	SS	2	2				50/2"
25								
						160		
	8	SS	3	1				50/3"
30					AUGER REFUSAL @ 28.8'			

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

WL DRY — WS OR WD	BORING STARTED 3-16-02	ASPHALT DEPTH 1" / CONCRETE DEPTH 7"
WL(AB) — WL(AC)	BORING COMPLETED 3-16-02	CAVE IN DEPTH ● 22.5
WL	RIG CME 45B FOREMAN CONNELLY	DRILLING METHOD HSA

CLIENT	JOB #	BORING #	SHEET
Alphatec, P.C.	13-1424	B-3	1 OF 1

PROJECT NAME: NIMA

ARCHITECT-ENGINEER:

SITE LOCATION: 6100 MacArthur Blvd

ECS LTD

DESCRIPTION OF MATERIAL

ENGLISH UNITS

SURFACE ELEVATION 184.5

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	ELEVATION (FT)	STANDARD PENETRATION BLOWS/FT.
0					Topsoil		
	1	SS	18	12	Sandy SILT, Some Sand, Dark Brown, Moist, Very Loose, (ML, Fill)		2
	2	SS	18	18	Sandy SILT, Medium Brown, Very Moist, Very Loose, (ML,FILL)		2
5						180	
	3	SS	18	18	Sandy SILT, Light Brown, Moist, Loose, (ML)		6
	4	SS	18	18	Sandy SILT, Tannish Brown, Moist, Medium Dense, (ML)	175	15
10							
	5	SS	18	12	Decomposed Rock, Gray, Moist Extremely Dense	170	91/11
15							
	6	SS	18	18		165	57
20							
	7	SS	9	9	Decomposed Rock, Brown, Moist, Extremely Dense	160	81/11
25							
	8	SS	1	1			50/1
30					AUGER REFUSAL @ 28.6'	155	

CALIBRATED PENETROMETER TONS/FT.^{2} (1, 2, 3, 4, 5+)

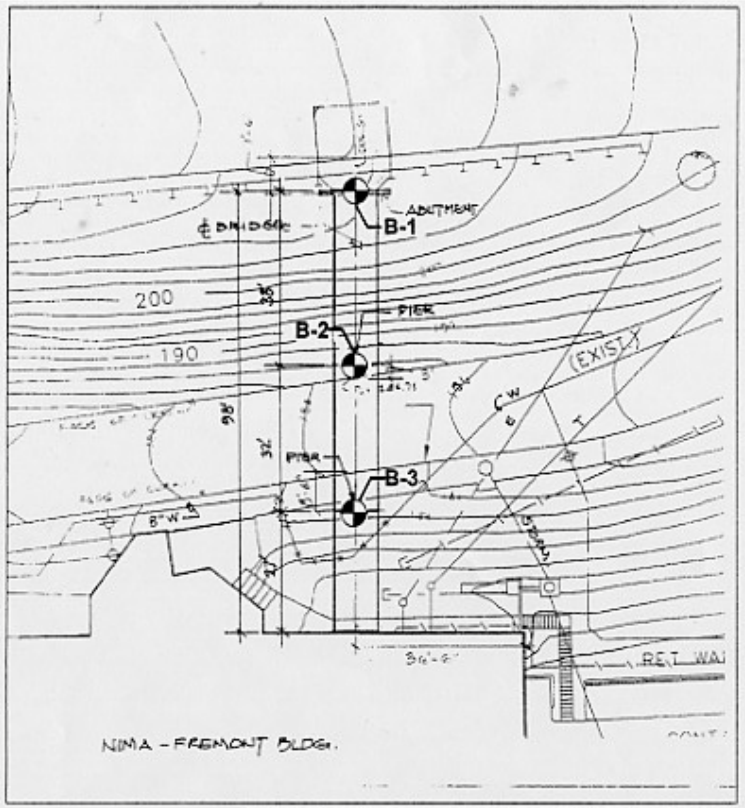
PLASTIC LIMIT X — WATER CONTENT X — LIQUID LIMIT X

STANDARD PENETRATION BLOWS/FT. (10, 20, 30, 40, 50+)

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

WL DRY WS OR WD	BORING STARTED 3-16-02	TOPSOIL DEPTH 3"
WL(AB) WL(AC)	BORING COMPLETED 3-16-02	CAVE IN DEPTH ● 22.5
WL	RIG CME 45B FOREMAN CONNELLY	DRILLING METHOD HSA

ECS LTD



LEGEND

ECS SOIL BORING LOCATION

ENGINEERING CONSULTING SERVICES, LTD.
5103 Pegasus Court, Suite K
Frederick, Maryland 21704
301.668.4303 Fax: 301.668.3519

ECS LTD ENGINEERING CONSULTING SERVICES LTD

BORING LOCATION PLAN
NIMA
6100 MacArthur Blvd

JRC	NCH	3-21-02	NTS	1424	1 OF 1

SECTION 02070 - SELECTIVE DEMOLITION

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. Demolition and removal of selected portions of a building.

2. Demolition and removal of selected site elements.

3. Patching and repairs.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 1 Sections contain requirements for cutting and patching procedures for selective demolition operations; phasing requirements; schedule requirements; temporary facilities, security and protection, and environmental protection requirements; and document record requirements.

2. Division 2 Section "Earthwork" for soil materials, excavating, backfilling, and site grading.

3. Division 2 Section "Chain Link Fence and Gates" for security fence.

4. Division 9 Section "Gypsum Board Assemblies" for material and construction requirements for temporary enclosures.

5. Division 15 Sections for cutting, patching, or relocating mechanical items.

6. Division 16 Sections for cutting, patching, or relocating electrical items.

1.3 DEFINITIONS

A. Remove: Remove and legally dispose of items except those indicated to be reinstalled, salvaged, or to remain the Government's property.

B. Remove and Salvage: Items indicated to be removed and salvaged remain the Government's property. Remove, clean, and pack or crate items to protect against damage. Identify contents of containers and deliver to Government's designated storage area.

C. Remove and Reinstall: Remove items indicated; clean, service, and otherwise prepare them for reuse; store and protect against damage. Reinstall items in the same locations or in locations indicated.

D. Existing to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by the COTR, items may be removed to a suitable, protected storage location during selective demolition and then cleaned and reinstalled in their original locations.

1.4 MATERIALS OWNERSHIP

A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain the Government's property, demolished materials shall become the Contractor's property and shall be removed from the site with further disposition at the Contractor's option.

1.5 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections, for information only, unless otherwise indicated.

B. Proposed dust-control measures.

C. Proposed noise-control measures.

D. Schedule of selective demolition activities indicating the following:

1. Interruption of utility services.

2. Coordination for shutoff, capping, and continuation of utility services.

3. Use of elevator and stairs.

4. Detailed sequence of selective demolition and removal work to ensure uninterrupted progress of Government's on-site operations.

5. Coordination of Government's continuing occupancy of portions of existing building and of Government's partial occupancy of completed Work.

6. Locations of temporary partitions and means of egress.

E. Inventory of items to be removed and salvaged.

F. Inventory of items to be removed by Government.

G. Photographs or videotape, sufficiently detailed, of existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by selective demolition operations.

H. Record drawings at Project closeout according to Division 1 Section "Contract Closeout."

1. Identify and accurately locate capped utilities and other subsurface structural, electrical, or mechanical conditions.

1.6 QUALITY ASSURANCE

A. Demolition Firm Qualifications: Engage an experienced firm that has successfully completed selective demolition Work similar to that indicated for this Project.

B. Regulatory Requirements: Comply with governing EPA notification regulations before starting selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Predemolition Conference: Conduct conference at Project site to comply with preinstallation conference requirements of Division 1 Section "Project Meetings."

1.7 PROJECT CONDITIONS

A. Government will occupy portions of the building immediately adjacent to selective demolition area. Conduct selective demolition so that Government's operations will not be disrupted. Provide not less than 72 hours' notice to Government of activities that will affect Government's operations.

B. Government assumes no responsibility for actual condition of buildings to be selectively demolished.

1. Conditions existing at time of inspection for bidding purpose will be maintained by Government as far as practical.

C. Asbestos: It is not expected that asbestos will be encountered in the Work. If any materials suspected of containing asbestos are encountered, do not disturb the materials. Immediately notify the COTR and the Government.

1. Asbestos will be removed by Government before start of Work.

D. Storage or sale of removed items or materials on-site will not be permitted.

1.8 SCHEDULING

A. Arrange selective demolition schedule so as not to interfere with Government's on-site operations.

1.9 WARRANTY

A. Existing Special Warranty: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 REPAIR MATERIALS

A. Use repair materials identical to existing materials.

1. Where identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.

2. Use materials whose installed performance equals or surpasses that of existing materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

D. When unanticipated mechanical, electrical, or structural elements that conflict with the intended function or design are encountered, investigate and measure the nature and extent of the conflict. Promptly submit a written report to the COTR.

E. Survey the condition of the building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of the structure or adjacent structures during selective demolition.

F. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES

A. Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Do not interrupt existing utilities serving occupied or operating facilities, except when authorized in writing by COTR. Provide temporary services during interruptions to existing utilities, as acceptable to Government.

a. Provide not less than 72 hours' notice to COTR if shutdown of service is required during changeover.

B. Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services serving building to be selectively demolished.

1. Arrange to shut off indicated utilities with COTR.

2. Where utility services are required to be removed, relocated, or abandoned, provide bypass connections to maintain continuity of service to other parts of the building before proceeding with selective demolition.

3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal the remaining portion of pipe or conduit after bypassing.

3.3 PREPARATION

A. Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with selective demolition operations.

B. Conduct demolition operations and remove debris 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 COTR. Provide alternate routes around closed or obstructed traffic ways.

C. Conduct demolition operations to prevent injury to people and damage to adjacent buildings and facilities to remain. Ensure safe passage of people around selective demolition area.

1. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.

2. Provide temporary weather protection, during interval between demolition and removal of existing construction, on exterior surfaces and new construction to ensure that no water leakage or damage occurs to structure or interior areas.

3. Protect walls, ceilings, floors, and other existing finish work that are to remain and are exposed during selective demolition operations.

4. Cover and protect furniture, furnishings, and equipment that have not been removed.

D. Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.

1. Seal joints and perimeter. Equip partitions with dustproof doors and security locks.

2. Weatherstrip openings.

E. Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of building to be selectively demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

3.4 POLLUTION CONTROLS

A. Install sediment control measures and obtain approval of Maryland Department of the Environment Inspector prior to start of any site demolition activity.

B. Use water mist, temporary enclosures, and other suitable methods to limit the spread of dust and dirt. Comply with governing environmental protection regulations.

1. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

C. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

1. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level.

D. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before start of selective demolition.

3.5 SELECTIVE DEMOLITION

A. Construct temporary security fence at the Limit of Disturbance and obtain approval of COTR before start of demolition of the existing security fence.

B. Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete Work within limitations of governing regulations and as follows:

1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. To minimize disturbance of adjacent surfaces, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.

2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.

4. Maintain adequate ventilation when using cutting torches.

5. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.

6. Locate selective demolition equipment throughout the structure and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

7. Dispose of demolished items and materials promptly. On-site storage or sale of removed items is prohibited.

8. Return elements of construction and surfaces to remain to condition existing before start of selective demolition operations.

C. Demolish concrete and masonry in small sections. Cut concrete and masonry at junctures with construction to remain, using power-driven masonry saw or hand tools; do not use power-driven impact tools.

D. Break up and remove concrete slabs on grade, unless otherwise shown to remain.

E. Saw-cut existing bituminous pavement prior to removal.

F. Remove resilient floor coverings and adhesive according to recommendations of the Resilient Floor Covering Institute's (RFCI) "Recommended Work Practices for the Removal of Resilient Floor Coverings" and Addendum.

G. Remove no more existing roofing than can be covered in one day by new roofing. See applicable Division 7 Section for new roofing requirements.

H. Remove air-conditioning equipment without releasing refrigerants.

3.6 PATCHING AND REPAIRS

A. Restore security fence at completion of new construction, per plans and specifications.

B. Patch bituminous pavement with MDOT approved materials and methods.

C. Promptly patch and repair holes and damaged surfaces caused to adjacent construction by selective demolition operations.

D. Patching is specified in Division 1 Section “Cutting and Patching.”

E. Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.

1. Completely fill holes and depressions in existing masonry walls to remain with an approved masonry patching material, applied according to manufacturer’s printed recommendations.

F. Restore exposed finishes of patched areas and extend finish restoration into adjoining construction to remain in a manner that eliminates evidence of patching and refinishing.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Government's property and legally dispose of them.

3.8 CLEANING

A. Sweep the building broom clean on completion of selective demolition operation.

B. Change filters on air-handling equipment on completion of selective demolition operations.

END OF SECTION 02070

SECTION 02300 - EARTHWORK

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. Excavating and backfilling for buildings and structures.
2. Excavating and backfilling trenches for buried utility structures.

B. Related Sections include the following:

1. Division 1 Sections for temporary facilities, security and protection and environmental protection requirements.
2. Division 2 Section "Site Clearing" for site stripping, grubbing, removing topsoil, and protecting trees to remain.
3. Division 2 Section "Landscaping" for finish grading, including placing and preparing topsoil for lawns and plantings.
4. Division 3 Section "Cast-in-Place Concrete" for granular course over vapor retarder.

1.3 DEFINITIONS

A. Backfill: Soil materials used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Layer placed between the subbase course and asphalt paving.

C. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.

E. Excavation: Removal of material encountered above subgrade elevations.

1. Additional Excavation: Excavation below subgrade elevations as directed by COTR. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
2. Bulk Excavation: Excavations more than 10 feet (3 m) in width and pits more than 30 feet (9 m) in either length or width.
3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated dimensions without direction by COTR. Unauthorized excavation, as well as remedial work directed by COTR, shall be without additional compensation.

F. Fill: Soil materials used to raise existing grades.

G. Rock: Rock material in beds, ledges, unstratified masses, and conglomerate deposits and boulders of rock material 3/4 cu. yd. (0.57 cu. m) or more in volume that when tested by an independent geotechnical testing agency, according to ASTM D 1586, exceeds a standard penetration resistance of 100 blows/2 inches (97 blows/50 mm).

H. 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.

I. Subbase Course: Layer placed between the subgrade and base course for asphalt paving, or layer placed between the subgrade and a concrete pavement or walk.

J. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

K. 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.

B. Samples: For the following:

1. 30-lb (14-kg) samples, sealed in airtight containers, of each proposed soil material from on-site or borrow sources.

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 borrow soil material proposed for fill and backfill.
2. Laboratory compaction curve according to ASTM D 698 for each on-site or borrow soil material proposed for fill and backfill.

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.

B. Preexcavation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

1.6 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Government or others unless permitted in writing by COTR and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify COTR not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without COTR'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: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM, or a combination of these group symbols; free of rock or gravel larger than 3 inches (75 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT, or a combination of these group symbols.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Backfill and Fill: Satisfactory soil materials.

E. Subbase: 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 (38-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.

F. Base: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch (38-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

G. Engineered Fill: 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 (38-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.

H. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

2.2 ACCESSORIES

A. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, minimum 6 inches (150 mm) wide and 4 mils (0.1 mm) 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 (750 mm) deep; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

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 earthwork operations.

B. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.

C. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.2 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. 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.

3.3 EXPLOSIVES

A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavation to subgrade elevations regardless of the character of surface and subsurface conditions encountered, including rock, soil materials, and obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.5 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 lines and grades to leave solid base to receive other work.
2. Pile Foundations: Stop excavations from 6 to 12 inches (150 to 300 mm) above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.

3.6 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit, unless otherwise indicated.

1. Clearance: 12 inches (300 mm) on each side of pipe or conduit.
2. Clearance: As indicated.

C. Trench Bottoms: Excavate trenches 4 inches (100 mm) deeper than bottom of pipe elevation to allow for bedding course. Hand excavate for bell of pipe.

1. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.7 APPROVAL OF SUBGRADE

A. Notify COTR when excavations have reached required subgrade.

B. If COTR determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

1. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

C. Proof roll subgrade with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof roll wet or saturated subgrades.

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by COTR.

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 may be used when approved by COTR.

1. Fill unauthorized excavations under other construction or utility pipe as directed by COTR.

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 to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations.

3.10 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for record documents.
3. Inspecting and testing underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

3.11 UTILITY TRENCH BACKFILL

A. 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.

B. Place and compact initial backfill of subbase material, free of particles larger than 1 inch (25 mm), to a height of 12 inches (300 mm) over the utility pipe or conduit.

1. 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.

C. Coordinate backfilling with utilities testing.

D. Fill voids with approved backfill materials while shoring and bracing, and as sheeting is removed.

E. Place and compact final backfill of satisfactory soil material to final subgrade.

F. Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.12 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. 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.

3.13 MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air-dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.14 COMPACTION OF BACKFILLS AND FILLS

A. Place backfill and fill materials in layers not more than 8 inches (200 mm) in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches (100 mm) 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.

C. Compact soil to not less than the following percentages of maximum dry unit weight according to ASTM D 698:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches (300 mm) of existing subgrade and each layer of backfill or fill material at 95 percent.
2. Under walkways, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill material at 92 percent.
3. Under lawn or unpaved areas, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill material at 85 percent.

3.15 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. Finish subgrades to required elevations within the following tolerances:

1. Lawn or Unpaved Areas: Plus or minus 1 inch (25 mm).
2. Walks: Plus or minus 1 inch (25 mm).
3. Pavements: Plus or minus 1/2 inch (13 mm).

3.16 FIELD QUALITY CONTROL

A. Testing Agency: Government will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

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. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by COTR.

D. 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 Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. (186 sq. m) or less of paved area or building slab, but in no case fewer than three tests.
2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for each 100 feet (30 m) or less of wall length, but no fewer than two tests.
3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for each 150 feet (46 m) or less of trench length, but no fewer than two tests.

E. 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.

3.17 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 COTR; reshape and recompact.

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.

3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Government's property.

B. Disposal: Transport surplus satisfactory soil to designated storage areas on Government's property. Stockpile or spread soil as directed by COTR.

1. Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Government's property.

END OF SECTION 02300

SECTION 02821 - CHAIN-LINK FENCES AND GATES

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. PVC-coated, steel chain-link fabric.
2. Polymer-coated steel framework.
3. Barbed wire.
4. Grounding and bonding.

B. Related Sections include the following:

1. Division 2 Section "Earthwork" for filling and for grading work.
2. Division 3 Section "Cast-in-Place Concrete" for concrete post footings.

1.3 DEFINITIONS

A. CLFMI: Chain Link Fence Manufacturers Institute.

B. Zn-5-Al-MM Alloy: Zinc-5 percent aluminum-mischmetal alloy.

1.4 SUBMITTALS

A. Product Data: Material descriptions, construction details, dimensions of individual components and profiles, and finishes for the following:

1. Fence and gate posts, rails, and fittings.
2. Chain-link fabric, reinforcements, and attachments.
3. Gates and hardware.

B. Shop Drawings: Show locations of fence, each gate, posts, rails, and tension wires and details of gate swing, or other operation, hardware, and accessories. Indicate materials, dimensions, sizes, weights, and finishes of components. Include plans, elevations, sections, gate swing and other required installation and operational clearances, and details of post anchorage and attachment and bracing.

C. Samples for Initial Selection: Manufacturer's color charts or 6-inch (150-mm) lengths of actual units showing the full range of colors available for components with factory-applied color finishes.

D. Samples for Verification: For the following products, in sizes indicated, showing the full range of color, texture, and pattern variations expected. Prepare Samples from the same material to be used for the Work.

1. PVC-coated steel wire (for fabric) in 6-inch (150-mm) lengths.
2. Polymer coating in 6-inch (150-mm) lengths on shapes for posts, rails, gate framing, wires, and on full-sized units for accessories.

E. Product Certificates: Signed by manufacturers of chain-link fences and gates certifying that products furnished comply with requirements.

F. 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 owners, and other information specified.

G. Field Test Reports: Indicate and interpret test results for compliance of chain-link fence and gate grounding and bonding with performance requirements.

H. Maintenance Data: For the following to include in maintenance manuals specified in Division 1:

1. Polymer finishes.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed chain-link fences and gates similar in material, design, and extent to those indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies, to supervise on-site testing specified in Part 3.

C. Source Limitations for Chain-Link Fences and Gates: Obtain each color, grade, finish, type, and variety of component for chain-link fences and gates from one source with resources to provide chain-link fences and gates of consistent quality in appearance and physical properties.

D. Emergency Access Requirements: Comply with NIMA security requirements for gate locks, and other requirements.

1.6 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving occupied facilities unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify COTR not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without COTR’s written permission.

B. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to existing structures. Verify dimensions by field measurements.

PART 2 - PRODUCTS

2.1 CHAIN-LINK FENCE FABRIC

A. Steel Chain-Link Fence Fabric: Height indicated on Drawings. Provide fabric fabricated in one-piece widths for fencing in height of 12 feet (3.6 m) and less. Comply with CLFMI's "Product Manual" and with requirements indicated below:

1. Mesh and Wire Size: 2-inch (50-mm) mesh, 0.148-inch (3.76-mm) diameter.

2. PVC-Coated Fabric: ASTM F 668, Class 1 over metallic-coated steel wire.

   a. Metallic Coating: Zinc.
   b. Color: Black complying with ASTM F 934.

3. Coat selvage ends of fabric that is metallic coated during the weaving process with manufacturer's standard clear protective coating.

B. Selvage: Twisted at top selvage and knuckled at bottom.

2.2 SECURITY FENCE FRAMING

A. Round Steel Pipe: Standard weight, Schedule 40, galvanized steel pipe complying with ASTM F 1083. Comply with ASTM F 1043, Material Design Group IA, external and internal coating Type A, consisting of not less than 1.8-oz./sq. ft. (0.55-kg/sq. m) zinc; and the following strength and stiffness requirements:

1. Line, End, Corner, and Pull Posts and Top Rail: Per requirements for Heavy Industrial Fence.

B. Post Brace Rails: Match top rail for coating and strength and stiffness requirements. Provide brace rail with truss rod assembly for each gate, end, and pull post. Provide two brace rails extending in opposing directions, each with truss rod assembly, for each corner post and for pull posts. Provide rail ends and clamps for attaching rails to posts.

C. Top Rails: Fabricate top rail from lengths 21 feet (6.4 m) or longer, with swedged-end or fabricated for expansion-type coupling, forming a continuous rail along top of chain-link fabric.

D. Intermediate Rails: Match top rail for coating and strength and stiffness requirements. ve

E. Bottom Rails: Match top rail for coating and strength and stiffness requirements.

2.3 SWING GATES

A. General: Comply with ASTM F 900 for the following swing-gate types:

1. Single gate.
2. Double gate.

B. Metal Pipe and Tubing: Galvanized steel. Comply with ASTM F 1083 and ASTM F 1043 for materials and protective coatings.

C. Frames and Bracing: Fabricate members from round, galvanized steel, tubing with outside dimension and weight according to ASTM F 900 for the following gate fabric height:

1. Gate Fabric Height: 6 feet (1.83 m) or less.

D. Frame Corner Construction: As follows:

1. Assembled with corner fittings and 5/16-inch- (7.9-mm-) diameter, adjustable truss rods for panels 5 feet (1.52 m) wide or wider.

E. Gate Posts: Fabricate members from round galvanized steel pipe with outside dimension and weight according to ASTM F 900.

F. Hardware: Latches permitting operation from both sides of gate, hinges, center gate stops and, for each gate leaf more than 5 feet (1.5 m) wide, keepers. Fabricate latches with integral eye openings for padlocking; padlock accessible from both sides of gate.

1. Padlocks: ASTM F 883, with chain.

2.4 FITTINGS

A. General: Provide fittings for a complete fence installation, including special fittings for corners. Comply with ASTM F 626.

B. Post and Line Caps: Hot-dip galvanized pressed steel or hot-dip galvanized cast iron. Provide weather-tight closure cap for each post.

1. Provide line post caps with loop to receive or top rail.

C. Rail and Brace Ends: Hot-dip galvanized pressed steel or hot-dip galvanized cast iron. Provide rail ends or other means for attaching rails securely to each gate, corner, pull, and end post.

D. Rail Fittings: Provide the following:

1. Top Rail Sleeves: Hot-dip galvanized pressed steel or round steel tubing. Not less than 6 inches (153 mm) long.
2. Rail Clamps: Hot-dip galvanized pressed steel. Provide line and corner boulevard clamps for connecting intermediate and bottom rails in the fence line to line posts.

E. Tension and Brace Bands: Hot-dip galvanized pressed steel.

F. Tension Bars: Hot-dip galvanized steel, length not less than 2 inches (50 mm) shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.

G. Truss Rod Assemblies: Hot-dip galvanized steel rod and turnbuckle or other means of adjustment.

H. Tie Wires, Clips, and Fasteners: Provide the following types according to ASTM F 626:

1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, complying with the following:

a. Hot-Dip Galvanized Steel: 0.106-inch- (2.69-mm-) diameter wire; galvanized coating thickness matching coating thickness of chain-link fence fabric.

2. Power-driven fasteners.

2.5 CAST-IN-PLACE CONCRETE

A. General: Comply with ACI 301 for cast-in-place concrete.

B. Materials: Portland cement complying with ASTM C 150, aggregates complying with ASTM C 33, and potable water for ready-mixed concrete complying with ASTM C 94.

1. Concrete Mixes: Normal-weight concrete air entrained with not less than 3000-psi (20.7-MPa) compressive strength (28 days), 3-inch (75-mm) slump, and 1-inch (25-mm) maximum size aggregate.

2.6 FENCE GROUNDING

A. Conductors: Bare, solid wire for No. 6 AWG and smaller; stranded wire for No. 4 AWG and larger.

1. Material Above Finished Grade: Copper.
2. Material On or Below Finished Grade: Copper.
3. Bonding Jumpers: Braided copper tape, 1 inch (25 mm) wide, woven of No. 30 AWG bare copper wire, terminated with copper ferrules.

B. Connectors and Ground Rods: Listed in UL 467.

1. Connectors for Below-Grade Use: Exothermic welded type.
2. Ground Rods: Copper-clad steel.

a. Size: 5/8 inch by 96 inches (16 by 2400 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, and other conditions affecting performance.

1. Do not begin installation before final grading is completed, unless otherwise permitted by COTR.

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

3.2 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet (152.5 m) or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 INSTALLATION, GENERAL

A. General: Install chain-link fencing to comply with ASTM F 567 and more stringent requirements specified.

1. Install fencing as shown on the plans.

B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed or compacted soil.

C. Post Setting: Hand-excavate holes for post foundations in firm, undisturbed or compacted soil. Set terminal, line, and gate posts in concrete footing. Protect portion of posts aboveground from concrete splatter. Place concrete around posts and vibrate or tamp for consolidation. Using mechanical devices to set line posts per ASTM F 567 is [not] permitted. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during placement and finishing operations until concrete is sufficiently cured.

1. Dimensions and Profile: As indicated on Drawings.

2. Exposed Concrete Footings: Extend concrete 2 inches (50 mm) above grade, smooth, and shape to shed water.

3.4 CHAIN-LINK FENCE INSTALLATION

A. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment of 15 degrees or more.

B. Line Posts: Space line posts uniformly at 8 feet (2.44 m) o.c.

C. Post Bracing Assemblies: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Install braces at end and gate posts and at both sides of corner and pull posts. Locate horizontal braces at midheight of fabric on fences with top rail and at two-thirds fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.

D. Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended by fencing manufacturer.

E. Intermediate Rails: Install in one piece at post-height center span, spanning between posts, using fittings, special offset fittings, and accessories.

F. Bottom Rails: Install, spanning between posts, using fittings and accessories.

G. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 1 inch (25.4 mm) between finish grade or surface and bottom selvage, unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.

H. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not more than 15 inches (380 mm) o.c.

I. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric per ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing.

1. Maximum Spacing: Tie fabric to line posts 12 inches (304 mm) o.c. and to braces 24 inches (609 mm) o.c.

J. Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

3.5 GATE INSTALLATION

A. General: Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.6 GROUNDING AND BONDING

A. Fence Grounding: Install at maximum intervals of 750 feet (225 m):

1. Gates and Other Fence Openings: Ground fence on each side of opening.

a. Bond metal gates to gate posts.
b. Bond across openings, with and without gates, except openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches (460 mm) below finished grade.

B. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a maximum distance of 150 feet (45 m) on each side of crossing.

C. Grounding Method: At each grounding location, drive a ground rod vertically until the top is 6 inches (150 mm) below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at the grounding location, including the following:

1. Each Barbed Wire Strand. Make grounding connections to barbed wire with wire-to-wire connectors designed for this purpose.

D. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.

E. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.

2. Make connections with clean, bare metal at points of contact.
3. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.7 FIELD QUALITY CONTROL

A. Ground-Resistance Testing Agency: Engage a qualified independent testing agency to perform field quality-control testing.

B. Ground-Resistance Tests: Subject completed grounding system to a megger test at each grounding location. Measure ground resistance not less than two full days after last trace of precipitation, without soil having been moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests by two-point method according to IEEE 81.

C. Desired Maximum Grounding Resistance Value: 25 ohms.

D. Excessive Ground Resistance: If resistance to ground exceeds desired value, notify COTR promptly. Include recommendations to reduce ground resistance and proposal to accomplish recommended work.

E. Report: Prepare test reports, certified by testing agency, of ground resistance at each test location. Include observations of weather and other phenomena that may affect test results.

3.8 ADJUSTING

A. Gate: Adjust gate to operate smoothly, easily, and quietly, free from binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Lubricate hardware, and other moving parts.

END OF SECTION 02821

SECTION 02900 - LANDSCAPING

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. Lawns.

2. Topsoil and soil amendments.

3. Fertilizers and mulches.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 2 Section "Earthwork" for excavation, filling, and rough grading.

1.3 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product certificates signed by manufacturers certifying that their products comply with specified requirements.

1. Analysis for other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

C. Certification of grass seed from seed vendor for each grass-seed 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 sod, identifying sod source, including name and telephone number of supplier.

D. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and address of architects and owners, and other information specified.

E. Material test reports from qualified independent testing agency indicating and interpreting test results relative to compliance of the following materials with requirements indicated.

1. Analysis of existing surface soil.

2. Analysis of imported topsoil.

F. Maintenance instructions recommending procedures to be established by Government for maintenance of landscaping during an entire year. Submit before acceptance of landscaping.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed landscaping work similar in material, design, and extent to that indicated for this Project and with a record of successful landscape establishment.

1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on the Project site during times that landscaping is in progress.

B. Testing Agency Qualifications: To qualify for acceptance, an independent testing agency must demonstrate to COTR's satisfaction, based on evaluation of agency-submitted criteria conforming to ASTM E 699, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.

C. Topsoil Analysis: Furnish a soil analysis made by a qualified independent soil-testing agency stating percentages of organic matter, inorganic matter (silt, clay, and sand), deleterious material, pH, and mineral and plant-nutrient content of topsoil.

1. Report suitability of topsoil for growth of applicable planting material. Provide recommendation of quantities of nitrogen, phosphorus, and potash nutrients and any limestone, aluminum sulfate, or other soil amendments to be added to produce a satisfactory topsoil.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."

E. The Maryland Department of the Environment (MDE) requirements for the establishment of vegetative cover on disturbed areas are shown on the drawings. To the extent that the MDE requirements are more stringent than these specifications, the MDE requirements have precedence.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery and while stored at site.

B. Seed: Deliver seed in original sealed, labeled, and undamaged containers.

C. Sod: Harvest, deliver, store, and handle sod according to the requirements of the American Sod Producers Association's (ASPA) "Specifications for Turfgrass Sod Materials and Transplanting/Installing."

1.6 PROJECT CONDITIONS

A. Utilities: Determine location of above grade and underground utilities and perform work in a manner which will avoid damage. Hand excavate, as required. Maintain grade stakes until removal is mutually agreed upon by parties concerned.

1.7 COORDINATION AND SCHEDULING

A. Coordinate installation of planting materials during normal planting seasons for each type of plant material required.

1.8 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the Government of other rights the Government may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Warranty: Warrant the following living planting materials for a period of one year after date of Substantial Completion, against defects including death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, or abuse by Government, abnormal weather conditions unusual for warranty period, or incidents that are beyond Contractor's control.

1. Turf areas.

1.9 LAWN MAINTENANCE

A. Begin maintenance of lawns immediately after each area is planted and continue until acceptable lawn is established, but for not less than the following periods:

1. Seeded Lawns: 90 days after date of Substantial Completion.

a. When full maintenance period has not elapsed before end of planting season, or if lawn is not fully established at that time, continue maintenance during next planting season.

2. Sodded Lawns: 90 days after date of Substantial Completion.

B. Maintain and establish lawns 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. Extend maintenance period for repaired areas.

C. Watering: Provide and maintain temporary piping, hoses, and lawn-watering equipment to convey water from sources and to keep lawns uniformly moist to a depth of 4 inches (100 mm).

1. Water lawn at the minimum rate of 1 inch (25 mm) per week.

D. Mow lawns as soon as there is enough top growth to cut with mower set at specified height for principal species planted. Repeat mowing as required to maintain specified height without cutting more than 40 percent of the 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.

E. Postfertilization: Apply fertilizer to lawn after first mowing and when grass is dry.

1. Use fertilizer that will provide actual nitrogen of at least 1 lb per 1000 sq. ft. (0.5 kg per 100 sq. m) of lawn area.

PART 2 - PRODUCTS

2.1 GRASS MATERIALS

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with the Association of Official Seed Analysts' "Rules for Testing Seeds" for purity and germination tolerances. Conform to Maryland State seed certification.

1. Seed Mixture: Provide seed of grass species and varieties, proportions by weight, and minimum percentages of purity, germination, and maximum percentage of weed seed as indicated on the drawings.

B. Sod: Certified turfgrass sod complying with ASPA specifications for machine-cut thickness, size, strength, moisture content, and mowed height, and free of weeds and undesirable native grasses. Provide viable sod of uniform density, color, and texture of the following turfgrass species, strongly rooted, and capable of vigorous growth and development when planted. Provide Maryland State certified sod.

1. Species: Provide sod of grass species and varieties, proportions by weight, and minimum percentages of purity, germination, and maximum percentage of weed seed similar to that of seed mixture.

2.2 TOPSOIL

A. Topsoil: ASTM D 5268, pH range of 5.5 to 7, 4 percent organic material minimum, free of stones 1 inch (25 mm) or larger in any dimension, and other extraneous materials harmful to plant growth.

1. Topsoil Source: Amend existing surface soil to produce topsoil. Supplement with imported topsoil when required.

2.3 SOIL AMENDMENTS

A. Lime: ASTM C 602, Class T, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent, with a minimum 99 percent passing a No. 8 (2.36 mm) sieve and a minimum 75 percent passing a No. 60 (250 micrometer) sieve.

B. Aluminum Sulfate: Commercial grade, unadulterated.

C. Sand: Clean, washed, natural or manufactured sand, free of toxic materials.

D. Manure: Well-rotted, unleached stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.

E. Herbicides: EPA registered and approved, of type recommended by manufacturer.

F. Water: Potable.

2.4 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-form, phosphorous, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

B. Slow-Release Fertilizer: Granular fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

2.5 MULCHES

A. Organic Mulch: Organic mulch, free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:

1. Type: Salt hay or threshed straw.

2.6 EROSION-CONTROL MATERIALS

A. 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. Fiber Mesh: Biodegradable twisted jute or spun-coir mesh, 0.92 lb per sq. yd. (0.5 kg per sq. m) minimum, with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches (150 mm) long.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive landscaping for compliance with requirements and for conditions affecting performance of work of this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 LAWN PLANTING PREPARATION

A. Limit subgrade preparation to areas that will be planted in the immediate future.

B. Loosen subgrade to a minimum depth of 4 inches (100 mm). Remove stones larger than 1-1/2 inches (38 mm) in any dimension and sticks, roots, rubbish, and other extraneous materials.

C. Spread planting soil mixture to depth required to meet thickness, grades, and elevations shown, after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen.

1. Place approximately 1/2 the thickness of planting soil mixture required. Work into top of loosened subgrade to create a transition layer and then place remainder of planting soil mixture.

2. Allow for sod thickness in areas to be sodded.

D. Preparation of Unchanged Grades: Where lawns are to be planted in areas unaltered or undisturbed by excavating, grading, or surface soil stripping operations, prepare soil as follows:

1. Remove and dispose of existing grass, vegetation, and turf. Do not turn over into soil being prepared for lawns.

2. Till surface soil to a depth of at least 6 inches (150 mm). Apply required soil amendments and initial fertilizers and mix thoroughly into top 4 inches (100 mm) of soil. Trim high areas and fill in depressions. Till soil to a homogenous mixture of fine texture.

3. Clean surface soil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful to plant growth.

4. Remove waste material, including grass, vegetation, and turf, and legally dispose of it off the Owner's property.

E. Grade lawn and grass areas to a smooth, even surface with loose, uniformly fine texture. 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. Remove trash, debris, stones larger than 1-1/2 inches (38 mm) in any dimension, and other objects that may interfere with planting or maintenance operations.

F. Moisten prepared lawn areas before planting when soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

G. Restore prepared areas if eroded or otherwise disturbed after fine grading and before planting.

3.3 SEEDING NEW LAWNS

A. Sow seed with a spreader or a 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 2 directions at right angles to each other.

B. The requirements for seeding and sodding shown on the project drawings shall have precedence over the wet seed by sowing equal quantities in 2 directions at right angles to each other.

1. Do not use wet seed or seed that is moldy or otherwise damaged in transit or storage.

C. Sow seed at the following rates:

1. Seeding Rate: 3 to 4 lb per 1000 sq. ft. (1.5 to 2 kg per 100 sq. m).

D. Rake seed lightly into top 1/8 inch (3 mm) of topsoil, roll lightly, and water with fine spray.

E. Protect seeded slopes exceeding 1:4 against erosion with erosion-control blankets installed and stapled according to manufacturer's recommendations.

F. Protect seeded areas with slopes less than 1:6 against erosion by spreading straw mulch after completion of seeding operations. Spread uniformly at a minimum rate of 2 tons per acre (45 kg per 100 sq. m) to form a continuous blanket 1-1/2 inches (38 mm) loose depth over seeded areas. Spread by hand, blower, or other suitable equipment.

1. Anchor straw mulch by crimping into topsoil by suitable mechanical equipment.

3.4 SODDING NEW LAWNS

A. Lay sod within 24 hours of stripping. Do not lay sod if dormant or if ground is frozen.

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 or steel staple anchors 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 2 hours of 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 the sod.

3.5 RECONDITIONING LAWNS

A. Recondition existing lawn areas damaged by Contractor's operations, including storage of materials or equipment and movement of vehicles. Also recondition lawn areas where settlement or washouts occur or where minor regrading is required.

B. Remove sod and vegetation from diseased or unsatisfactory lawn areas; do not bury into soil. Remove topsoil containing foreign materials resulting from Contractor's operations, including oil drippings, fuel spills, stone, gravel, and other construction materials, and replace with new topsoil.

C. Where substantial lawn remains, mow, dethatch, core aerate, and rake. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.

D. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of it off the Owner's property.

E. Till stripped, bare, and compacted areas thoroughly to a depth of 6 inches (150 mm).

F. Apply required soil amendments and initial fertilizers and mix thoroughly into top 4 inches (100 mm) of soil. Provide new planting soil as required to fill low spots and meet new finish grades.

G. Apply seed and protect with straw mulch as required for new lawns.

H. Water newly planted areas and keep moist until new grass is established.

3.6 CLEANUP AND PROTECTION

A. During landscaping, keep pavements clean and work area in an orderly condition.

B. Protect landscaping from damage due to landscape operations, operations by other contractors and trades, and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.

3.7 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of it off the Government's property.

3.8 PLANTING SCHEDULE

A. Temporary seeding for erosion control and permanent seeding or sodding shall be limited to the planting period indicated on the plans.

END OF SECTION 02900

SECTION 03300 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Related Sections include the following:

1. Division 2 Section "Earthwork" for drainage fill under slabs-on-grade.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, 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 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. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork. Design and engineering of formwork are Contractor's responsibility.

1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and installing and removing reshoring.

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. Vapor retarders.

G. Minutes of preinstallation conference.

1.5 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. 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 formwork and shoring and reshoring installations that are similar to those indicated for this Project in material, design, and extent.

C. Manufacturer Qualifications: A firm experienced in manufacturing 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 Mixed Concrete Association's Certification of Ready Mixed Concrete Production Facilities.

D. 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.

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.

E. 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.

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. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

1. Before submitting design mixes, review concrete mix design and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

a. Contractor's superintendent.

b. Independent testing agency responsible for concrete design mixes.

c. Ready-mix concrete producer.

d. Concrete subcontractor.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle steel reinforcement to prevent bending and damage.

1. Avoid damaging coatings on steel reinforcement.

2. Repair damaged epoxy coatings on steel reinforcement according to ASTM D 3963/D 3963M.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.

2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

a. Structural 1, B-B, or better, mill oiled and edge sealed.

B. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.

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

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

D. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1 inch (25 mm) to the plane of the exposed concrete surface.

2. Furnish ties that, when removed, will leave holes not larger than 1 inch (25 mm) in diameter in concrete surface.

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

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: Epoxy coated ASTM A934/A, 934 M for all above ground exposed concrete.

B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

C. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets. Arid epoxy coated welded wire fabric for exposed concrete slabs.

2.3 REINFORCEMENT ACCESSORIES

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric 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.a For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected or CRSI Class 2 stainless-steel bar supports.

2.4 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I/II.

B. Silica Fume: ASTM C 1240, amorphous silica.

C. Normal-Weight Aggregate: ASTM C 33, uniformly graded, and as follows:

1.a Nominal Maximum Aggregate Size: 3/4 inch (19 mm).

D. Water: Potable and complying with ASTM C 94.

2.5 ADMIXTURES

A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material and to be compatible with other admixtures and cementitious materials. Do not use admixtures containing calcium chloride.

B. Air-Entraining Admixture: ASTM C 260.

C. Water-Reducing Admixture: ASTM C 494, Type A.

D. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.

E. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.

F. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.

2.6 VAPOR RETARDERS

A. Vapor Retarder: ASTM E 1745, Class C, of one of the following materials; or polyethylene sheet, ASTM D 4397, not less than 10 mils (0.25 mm) thick:

1. Nonwoven, polyester-reinforced, polyethylene coated sheet; 10 mils (0.25 mm) thick.

2. Three-ply, nylon- or polyester-cord-reinforced, laminated, high-density polyethylene sheet; 7.8 mils (0.18 mm) thick.

B. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch (38-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.

2.7 FLOOR AND SLAB TREATMENTS

A. Penetrating Liquid Floor Treatment: Chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; colorless; that penetrates, hardens, and densifies concrete surfaces.

B. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Penetrating Liquid Floor Treatment:

a. Titan Hard; Burke Group, LLC (The).
b. Chemisil Plus; ChemMasters.
c. Intraseal; Conspec Marketing & Manufacturing Co., Inc.
d. Ashford Formula; Curecrete Chemical Co., Inc.
e. Day-Chem Sure Hard; Dayton Superior Corporation.
f. Euco Diamond Hard; Euclid Chemical Co.
g. Seal Hard; L&M Construction Chemicals, Inc.
h. Vexcon Starseal PS; Vexcon Chemicals, Inc.

2.8 CURING MATERIALS

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

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) 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.

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. Evaporation Retarder:

a. Cimfilm; Axim Concrete Technologies.
b. Finishing Aid Concentrate; Burke Group, LLC (The).
c. Spray-Film; ChemMasters.
d. Aquafilm; Conspec Marketing & Manufacturing Co., Inc.
e. Sure Film; Dayton Superior Corporation.

f. Eucobar; Euclid Chemical Co.
g. Vapor Aid; Kaufman Products, Inc.
h. Lambco Skin; Lambert Corporation.
i. E-Con; L&M Construction Chemicals, Inc.
j. Confilm; Master Builders, Inc.
k. Waterhold; Metalcrete Industries.
l. Rich Film; Richmond Screw Anchor Co.
m. Sikafilm; Silka Corporation
n. Finishing Aid; Symons Corporation
o. Certi-Vex EnvioAssist; Vexcon Chemicals, Inc.

2. Clear, Waterborne, Membrane forming Curing Compound:

AH Clear Cure WB; Anti-Hydro International, Inc.
Klear Kote WB II Regular; Burke Chemicals.

a. Safe Cure & Seal 20; ChemMasters.
b. High Seal; Conspec Marketing and Manufacturing Co., Inc.
c. Safe Cure and Seal; Dayton Superior Corporation.
d. Aqua Cure VOX; Euclid Chemical Co.
e. Cure & Seal 309 Emulsion; Kaufman Products, Inc.
f. Glazacote Sealer-20; Lambert Corporation.
g. Dress & Seal WB; L & M Construction Chemicals, Inc.
h. Vocomp-20; W.R. Meadows, Inc.
i. Metcure; Metalcrete Industries.
j. Cure & Seal 100E; Nox-Crete Products Group, Kinsman Corporation.
k. Rich Seal 14 percent E; Richmond Screw Anchor Co.
l. Kure-N-Seal W; Sonneborn, Div. of ChemRex, Inc.
m. Florseal W.B.; Sternson Group.
n. Cure & Seal 14 percent; Symons Corporation.
o. Seal Cure WB 150; Tamms Industries Co., Div. of LaPorte Construction Chemicals of North America, Inc.
p. Hydro Seal; Unitex
q. Starseal 309; Vexcon Chemicals, Inc.

2.9 RELATED MATERIALS

A. Joint-Filler Strips: ASTM D 1751, asphalt saturated cellulosic fiber.
B. Joint-Filler Strips: ASTM D 1752, cork or self-expanding cork.
C. Expansion Joint Seal: Compressible “sanoprene » seal, equal to Watson, Bowman Acute Type WE.

2.10 REPAIR MATERIALS

A. Repair Underpayment: Cement-based, polymer modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM.

2. Primer: Product of underlayment manufacturer recommended for substrate, conditions and application.

3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3 to 6 mm) or coarse sand as recommended by underlayment manufacturer.

B. Repair Topping: Traffic-bearing, cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch (6 mm).

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.

2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.

3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3 to 6 mm) or coarse sand as recommended by topping manufacturer.

4. Compressive Strength: Not less than 5700 psi (39 MPa) at 28 days when tested according to ASTM C 109/C 109M.

2.11 CONCRETE MIXES

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.
2. Proportion lightweight structural concrete according to ACI 211.2 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 Foundation Walls and slabs on grade: Proportion normal-weight concrete mix as follows:

1. Compressive Strength (28 Days): 4000 psi (27.6 MPa).

2. Maximum Slump: 5 inches (125 mm).

3. Maximum Slump for Concrete Containing High-Range Water-Reducing Admixture: 8 inches (200 mm) after admixture is added to concrete with 2- to 4-inch (50- to 100-mm) slump.

D. Caissons columns and steams: Proportion normal-weight concrete mix as follows:

1. Compressive Strength (28 Days): 4500 psi (24.15 MPa).
2. Minimum Cementious Materials Content: 520 lb/cu.yd (309 kg/cu.m)
3. Maximum Slump: 5 inches (125 mm).

E. Bridge Deck Slabs: Proportion normal weight structural concrete mix as follows:

1. Compressive Strength (28 Days) : 5000 psi (34.5 MPa).
2. Calculated Equilibrium Unit Weight: 145 lb/cu.ft. (1842 kg/cu.m) plus or minus 3 lb/cu.ft. (48.1 kg/cu.m) as determined by ASTM C 567.
3. Maximum Slump: 5 inches (125 mm).

F. Raised Floor @ Core: Proportion lightweight concrete as follows:

1. Compressive Strength (28 Days) : 5000 psi (34.5 MPa).
2. Calculated Equilibrium Unit Weight: 115 lb/cu.ft. (1842 kg/cu.m) plus or minus 3 lb/cu.ft. (48.1 kg/cu.m) as determined by ASTM C 567.
3. Maximum Slump: 5 inches (125 mm).

G. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than Portland cement in concrete as follows:

1. Fly Ash: 25 percent.

2. Combined Fly Ash and Pozzolan: 25 percent.

3. Ground Granulated Blast-Furnace Slag: 50 percent.

4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.

5. Silica Fume: 10 percent.

6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

H. Maximum Water-Cementitious Materials Ratio: 0.50 for concrete required to have low water permeability.

I. Maximum Water-Cementitious Materials Ratio: 0.45 for concrete exposed to deicers or subject to freezing and thawing while moist.

J. Air Content: Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content of 2 to 4 percent, unless otherwise indicated.

K. Do not air entrain concrete to trowel-finished interior floors and suspended slabs. Do not allow entrapped air content to exceed 3 percent.

L. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

M. 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 and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

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

2.12 FABRICATING REINFORCEMENT

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

2.13 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116, and furnish batch ticket information.

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

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 concrete 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 B, 1/4 inch (6 mm).

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, accurately located, to elevations required.

2. Install reglets to receive top edge of foundation sheet waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork, for sides of beams, walls, columns, and similar parts of the Work, that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete 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. At least 70 percent of 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 SHORES AND RESHORES

A. Comply with ACI 318 (ACI 318M), ACI 301, and recommendations in ACI 347R for design, installation, and removal of shoring and reshoring.

B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 VAPOR RETARDERS

A. Vapor Retarder: Place, protect, and repair vapor-retarder sheets according to ASTM E 1643 and manufacturer's written instructions.

B. Granular Fill: Cover vapor retarder with granular fill, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch (0 mm) or minus 3/4 inch (19 mm).

1. Place and compact a 1/2-inch- (13-mm-) thick layer of fine-graded granular material over granular fill.

3.6 STEEL REINFORCEMENT

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

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

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials.

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.

F. Touch-up reinforcing epoxy coating if damaged.

3.7 JOINTS

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

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.

2. Form from preformed galvanized steel, plastic keyway-section forms, or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.

3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.

4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.

5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.

6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

7. Expansion joint seal, install with sealant in accordance with manufacturer instructions.

3.8 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

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

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

6. Do not add water to concrete after adding high-range water-reducing admixtures to mix.

D. Deposit concrete continuously or in 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 specified. Deposit concrete to avoid segregation.

E. Deposit concrete in forms in horizontal layers no deeper than 24 inches (600 mm) and in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic, to avoid cold joints.

6. Consolidate placed concrete with mechanical vibrating equipment. Use equipment and procedures for consolidating concrete recommended by ACI 309R.

7. 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 (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing 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 (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) 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 (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. 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.

3.9 FINISHING FORMED SURFACES

A. Rough-Formed Finish: For surfaces in contact with earth or un-exposed. As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding ACI 347R limits for class of surface specified.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch (3 mm) in height.

1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or painting.

2. Do not apply rubbed finish to smooth-formed finish.

C. Rubbed Finish: For caissons, beams, exposed walls and curbs. Apply the following to smooth-formed finished concrete:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

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

3.10 FINISHING SLABS

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

B. Fine Broom Finish: Apply a fine broom finish to exterior concrete slabs and ramps, bridge deck slab and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.11 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.

3.12 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 with recommendations in ACI 305R for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing by one or a combination of the following methods:

D. 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 Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

a. Water.

b. Continuous water-fog spray.

c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven

days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.

b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.

c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer recommends for use with floor coverings.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.13 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.

3.14 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.2-mm) sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension in solid concrete but not less than 1 inch (25 mm) 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 (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.

2. After concrete has cured at least 14 days, correct high areas by grinding.

3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.

4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least 3/4 inch (19 mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and 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.

7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place

patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

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

3.15 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement according to requirements specified in this Article.

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. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.

2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. (76 cu. m) 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 (4.4 deg C) and below and when 80 deg F (27 deg C) 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 (3.4 MPa).

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 03300

SECTION 04810 - UNIT MASONRY ASSEMBLIES

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 unit masonry assemblies consisting of the following:

1. Concrete masonry units.
2. Face brick.
3. Mortar and grout.
4. Masonry joint reinforcement.
5. Ties and anchors.
6. Embedded flashing.
7. Miscellaneous masonry accessories.

B. Related Sections include the following:

C. List below only products, construction, and equipment that the reader might expect to find in this Section but are specified elsewhere.

1. Division 7 Section "Bituminous Dampproofing" for dampproofing applied to face of backup wythes of walls.

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

1. Anchor sections of adjustable masonry anchors for connecting to structural frame, installed under Division 5 Section "Structural Steel."

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

1. Steel lintels and shelf angles for unit masonry, furnished under Division 5 Section "Metal Fabrications."
2. Hollow-metal frames in unit masonry openings, furnished under Division 8 Section "Steel Doors and Frames."
3. Source and field quality-control testing under Inspection and Testing Allowance.

1.3 SUBMITTALS

A. Product Data: For each different masonry unit, accessory, and other manufactured product specified.

B. Delete subparagraph below if glazed structural facing tile is not used or if considered unnecesary.

C. Samples: For the following:

1. Full-size units for each different exposed masonry unit required, showing the full range of exposed colors, textures, and dimensions to be expected in the completed construction

2. Weep holes/vents in color to match mortar color.

3. Accessories embedded in the masonry.

D. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

E. Material Test Reports: From a qualified testing agency indicating and interpreting test results of the following for compliance with requirements indicated:

1. Each type of masonry unit required.

a. Include size-variation data for brick, verifying that actual range of sizes falls within specified tolerances.

b. Include test results, measurements, and calculations establishing net-area compressive strength of masonry units.

2. Mortar complying with property requirements of ASTM C 270.

3. Grout mixes complying with compressive strength requirements of ASTM C 476. Include description of type and proportions of grout ingredients.

F. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:

1. Each type of masonry unit required.

a. Include test data, measurements, and calculations establishing net-area compressive strength of masonry units.

2. Each cement product required for mortar and grout, including name of manufacturer, brand, type, and weight slips at time of delivery.

G. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.

1.3 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1093 to conduct the testing indicated, as documented according to ASTM E 548.

B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.

C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source or producer for each aggregate.

D. Sample Panels: Before installing unit masonry, build sample panels, using materials indicated for the completed Work, to verify selections made under sample Submittals and to demonstrate aesthetic effects. Build sample panel approximately 48 inches (1200 mm) long by 48 inches (1200 mm) high by full thickness.

1. Clean exposed faces of panels with masonry cleaner indicated.

2. Erect panels adjacent and parallel to existing surface.

3. Protect approved sample panels from the elements with weather-resistant membrane.

4. Maintain sample panels during construction in an undisturbed condition as a standard for judging the completed Work.

5. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.

a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels, unless such deviations are specifically approved by Architect in writing.

6. Demolish and remove sample panels when directed.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

1. Protect Type I concrete masonry units from moisture absorption so that, at the time of installation, the moisture content is not more than the maximum allowed at the time of delivery.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.5 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches (600 mm) down both sides and hold cover securely in place.

2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (600 mm) down face next to unconstructed wythe and hold cover in place.

B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by coverings spread on ground and over wall surface.

2. Protect sills, ledges, and projections from mortar droppings.

3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.

4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

D. Hot-Weather Requirements: Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required.

1. When ambient temperature exceeds 100 deg F (38 deg C), or 90 deg F (32 deg C) with a wind velocity greater than 8 mph (13 km/h), do not spread mortar beds more than 48 inches (1200 mm) ahead of masonry. Set masonry units within one minute of spreading mortar.

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS

A. General: Provide shapes indicated and as follows:

1. Provide special shapes for lintels, corners, jambs, sash, control joints, headers, bonding, and other special conditions.

2. Provide bullnose units for exposed outside corners.

B. Concrete Masonry Units: ASTM C 90 and as follows:

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of .

2. Weight Classification: Normal weight , unless otherwise indicated.

3. Provide Type I, moisture-controlled units.

4. Size (Width): Manufactured to the following dimensions:

5. Exposed Faces: Manufacturer's standard color and texture, unless otherwise indicated.

2.2 BRICK

A. Face Brick: ASTM C 216, Grade SW, Type FBX, and as follows:

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3000 psi (20.7 MPa).

2. Initial Rate of Absorption: Less than 20 g/30 sq. in. (20 g/194 sq. cm) per minute when tested per ASTM C 67.

3. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."

4. Surface Coloring: Brick with surface coloring, other than flashed or sand-finished brick, shall withstand 50 cycles of freezing and thawing per ASTM C 67 with no observable difference in the applied finish when viewed from 10 feet (3 m).

5. Size: Manufactured to the following actual dimensions:

a. Modular: 3-1/2 to 3-5/8 inches (89 to 92 mm) wide by 2-1/4 inches (57 mm) high by 7-5/8 inches (194 mm) long.

6. Application: Use where brick is exposed, unless otherwise indicated.

7. Provide face brick matching color range, texture, and size of existing adjacent brickwork.

2.3 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color to match existing.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207.

D. Mortar Cement: ASTM C 1329.

E. Aggregate for Mortar: ASTM C 144; except for joints less than 1/4 inch (6.5 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.

F. Aggregate for Grout: ASTM C 404.

G. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494, Type C, and recommended by the manufacturer for use in masonry mortar of composition indicated.

H. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with concrete masonry units, containing integral water repellent by same manufacturer.

I. Water: Potable.

2.4 MASONRY JOINT REINFORCEMENT

A. General: ASTM A 951 and as follows:

1. Hot-dip galvanized, carbon-steel wire for both interior and exterior walls.

2. Wire Size for Side Rods: W1.7.

3. Wire Size for Cross Rods: W1.7.

4. Provide in lengths of not less than 10 feet (3 m), with prefabricated corner and tee units where indicated.

B. For multiwythe masonry, provide types as follows:

1. Ladder type with perpendicular cross rods spaced not more than 16 inches (407 mm) o.c. and 1 side rod for each face shell of hollow masonry units more than 4 inches (100 mm) in width, plus 1 side rod for each wythe of masonry 4 inches (100 mm) or less in width.

2.5 TIES AND ANCHORS, GENERAL

A. General: Provide ties and anchors, specified in subsequent articles, made from materials that comply with this Article, unless otherwise indicated.

B. Steel Sheet, Galvanized after Fabrication: ASTM A 366/A 366M cold-rolled, carbon- steel sheet-dip galvanized after fabrication to comply with ASTM A 153.

2.6 BENT WIRE TIES

A. General: Rectangular units with closed ends and not less than 4 inches (100 mm) wide. Z-shaped ties with ends bent 90 degrees to provide hooks not less than 2 inches (50 mm) long may be used for masonry constructed from solid units or hollow units laid with cells horizontal

B. Wire: Fabricate from 3/16-inch- (4.8-mm-) diameter, hot-dip galvanized steel wire.

2.7 EMBEDDED FLASHING MATERIALS

A. Concealed Flashing: For flashing not exposed to the exterior, use one of the following, unless otherwise indicated:

1. EPDM Flashing: Manufacturer's standard flashing product formed from a terpolymer of ethylene-propylene diene, complying with ASTM D 4637, 0.040 inch (1.0 mm) thick.

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

2.8 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

B. Round Plastic Weep/Vent Tubing: Medium-density polyethylene, 3/8-inch (9-mm) OD by 4 inches (100 mm) long.

2.9 MASONRY CLEANERS

A. Job-Mixed Detergent Solution: Solution of 1/2-cup (0.14-L) dry measure tetrasodium polyphosphate and 1/2-cup (0.14-L) dry measure laundry detergent dissolved in 1 gal. (4 L) of water.

B. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Available Products: Subject to compliance with requirements, products that may be used to clean unit masonry surfaces include, but are not limited to, the following:

2. Products: Subject to compliance with requirements, provide one of the following:

a. Cleaners for Red and Light-Colored Brick Not Subject to Metallic Staining with Mortar Not Subject to Bleaching:

1) 202 New Masonry Detergent; Diedrich Technologies, Inc.

2) Sure Klean No. 600 Detergent; ProSoCo, Inc.

3) Sure Klean Vana Trol; ProSoCo, Inc.

2.10 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.

2. Add cold-weather admixture (if used) at the same rate for all mortar, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in the form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification.

1. Extended-Life Mortar for Unit Masonry: Mortar complying with ASTM C 1142 may be used instead of mortar specified above, at Contractor's option.

2. Limit cementitious materials in mortar to portland cement, mortar cement, and lime.

3. For masonry below grade, in contact with earth, and where indicated, use Type M.

4. For exterior, above grade, non load-bearing walls and parapet walls; for interior non-load bearing partitions; and for other applications where another type is indicated, use type [N].

D. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 5 of ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.

2. Provide grout with a slump of 8 to 11 inches (200 to 280 mm) as measured according to ASTM C 143.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance.

2. Verify that foundations are within tolerances specified.

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

B. Before installation, examine rough-in and built-in construction to verify actual locations of piping connections.

3.2 INSTALLATION, GENERAL

A. Thickness: Build masonry construction to the full thickness shown. Build single-wythe walls to the actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this Section and in other Sections of the Specifications.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to the opening.

D. Cut masonry units with motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide a continuous pattern and to fit adjoining construction. Where possible, use full-size units without cutting. Allow units cut with water-cooled saws to dry before placing, unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

1. Mix units from several pallets or cubes as they are placed.

F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

G. Wetting of Brick: Wet brick before laying if the initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at the time of laying.

3.3 CONSTRUCTION TOLERANCES

A. Comply with tolerances in ACI 530.1/ASCE 6/TMS 602 and the following:

B. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/4 inch in 20 feet (6 mm in 6 m), nor 1/2 inch (12 mm) maximum.

C. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), nor 1/2 inch (12 mm) maximum.

D. For conspicuous horizontal lines, such as exposed lintels, sills, parapets, and reveals, do not vary from level by more than 1/4 inch in 20 feet (6 mm in 6 m), nor 1/2 inch (12 mm) maximum.

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

F. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm). Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3 mm).

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Lay exposed masonry in the following bond pattern; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

1. One-half running bond with vertical joint in each course centered on units in courses above and below.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches (50 mm). Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: In each course, rack back one-half-unit length for one-half running bond or one-third-unit length for one-third running bond; do not tooth. Clean exposed surfaces of set masonry, wet clay masonry units lightly if required, and remove loose masonry units and mortar before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified under this and other Sections of the Specifications. Fill in solidly with masonry around built-in items.

F. Fill space between hollow-metal frames and masonry solidly with mortar, unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.

H. Fill cores in hollow concrete masonry units with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above, unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow masonry units as follows:

1. With full mortar coverage on horizontal and vertical face shells.

2. Bed webs in mortar in starting course on footings and in all courses of piers, columns, and pilasters, and where adjacent to cells or cavities to be filled with grout.

3. For starting course on footings where cells are not grouted, spread out full mortar bed, including areas under cells.

B. Lay solid brick-size masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

1. At cavity walls, bevel beds away from cavity, to minimize mortar protrusions into cavity. As work progresses, trowel mortar fins protruding into cavity flat against the cavity face of the brick.

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

3.6 BONDING OF MULTIWYTHE MASONRY

A. Use masonry joint reinforcement installed in horizontal mortar joints to bond wythes together.

B. Corners: Provide interlocking masonry unit bond in each wythe and course at corners, unless otherwise indicated.

1. Provide continuity with masonry joint reinforcement at corners by using prefabricated "L" units as well as masonry bonding.

C. Intersecting and Abutting Walls: Unless vertical expansion or control joints are shown at juncture, bond walls together as follows:

1. Provide continuity with masonry joint reinforcement by using prefabricated "T" units.

3.7 CAVITIES

A. Keep cavities clean of mortar droppings and other materials during construction. Strike joints facing cavities flush.

1. Use wood strips temporarily placed in cavity to collect mortar droppings. As work progresses, remove strips, clean off mortar droppings, and replace in cavity.

B. Coat cavity face of backup wythe to comply with Division 7 Section “Bituminous Dampproofing.”

3.8 MASONRY JOINT REINFORCEMENT

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

1. Space reinforcement not more than 16 inches (406 mm) o.c.

2. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond openings.

a. Reinforcement above is in addition to continuous reinforcement.

B. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

C. Provide continuity at corners and wall intersections by using prefabricated "L" and "T" sections. Cut and bend reinforcing units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.9 ANCHORING MASONRY TO STRUCTURAL MEMBERS

A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:

1. Provide an open space not less than 3/8 inch (10 mm) in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar or other rigid materials.

2. Anchor masonry to structural members with flexible anchors embedded in masonry joints and attached to structure.

3. Space anchors as indicated, but not more than 24 inches (610 mm) o.c. vertically.

3.10 INTELS

A. Install steel lintels where indicated.

B. Provide masonry lintels where shown and where openings of more than 12 inches (305 mm) for brick-size units and 24 inches (610 mm) for block-size units are shown without structural steel or other supporting lintels.

1. Provide precast lintels made from concrete matching concrete masonry units in color, texture, and compressive strength and with reinforcing bars indicated or required to support loads indicated. Cure precast lintels by the same method used for concrete masonry units.

C. Provide minimum bearing of 8 inches (200 mm) at each jamb, unless otherwise indicated.

3.11 FLASHING, WEEP HOLES, AND VENTS

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

B. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Unless otherwise indicated, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.

C. Install flashing as follows:

1. At multiwythe masonry walls, extend flashing from exterior face of outer wythe of masonry, through outer wythe, turned up a minimum of 4 inches (100 mm), and through inner wythe to within 1/2 inch (13 mm) of the interior face of the wall in exposed masonry. Where interior surface of inner wythe is concealed by furring, carry flashing completely through inner wythe and turn flashing up approximately 2 inches (50 mm), unless otherwise indicated.

2. At lintels and shelf angles, extend flashing a minimum of 4 inches (100 mm) into masonry at each end. At heads and sills, extend flashing 4 inches (100 mm) at ends and turn flashing up not less than 2 inches (50 mm) to form a pan.

3. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches (38 mm) or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Division 7 Section "Joint Sealants" for application indicated.

4. Extend sheet metal flashing 1/2 inch (13 mm) beyond face of masonry at exterior and turn flashing down to form a drip.

5. Install metal drip edges beneath flashing at exterior face of wall. Stop flashing 1/2 inch (13 mm) back from outside face of wall and adhere flashing to top of metal drip edge.

6. Install metal flashing termination beneath flashing at exterior face of wall. Stop flashing 1/2 inch (13 mm) back from outside face of wall and adhere flashing to top of metal flashing termination.

7. Cut flashing off flush with face of wall after masonry wall construction is completed.

D. Install weep holes in the head joints in exterior wythes of the first course of masonry immediately above embedded flashing and as follows:

1. Use to form weep holes.

2. Space weep holes 24 inches (600 mm) o.c.

3.12 FIELD QUALITY CONTROL

A. Owner will engage a qualified independent testing agency to perform field quality-control testing indicated below.

2. Payment for these services will be made by Government.

3. Retesting of materials failing to meet specified requirements shall be done at Contractor's expense.

B. Testing Frequency: Tests and Evaluations listed in this Article will be performed during construction for each 5000 sq. ft. (465 sq. m) of wall area or portion thereof.

C. Mortar properties will be tested per ASTM C 780.

D. Grout will be sampled and tested for compressive strength per ASTM C 1019.

E. Brick Tests: For each type and grade of brick indicated, units will be tested according to ASTM C 67.

F. Concrete Masonry Unit Tests: For each type of concrete masonry unit indicated, units will be tested according to ASTM C 140.

G. Prism-Test Method: For each type of wall construction indicated, masonry prisms will be tested per ASTM C 1314 and as follows:

1. Prepare 1 set of prisms for testing at 7 days and 1 set for testing at 28 days.

3.13 PARGING

A. Parge predampened masonry walls, where indicated, with Type S or Type N mortar applied in 2 uniform coats to a total thickness of ¾ inch (19 mm). Scarify first parge coat to ensure full bond to subsequent coat.

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

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

3.14 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application.

C. In-Progress Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.

2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.

3. Protect adjacent stone and nonmasonry surfaces from contract with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.

4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing the surfaces thoroughly with clear water.

5. Clean brick by the bucket-and-brush hand-cleaning method described in BIA Technical Notes No. 20, using job-mixed detergent solution.

6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

7. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2 applicable to type of stain on exposed surfaces.

3.15 MASONRY WASTE DISPOSAL

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

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

END OF SECTION 04810

SECTION 05120 - STRUCTURAL STEEL

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 structural steel.

B. This Section includes structural steel and architecturally exposed structural steel.

C. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 5 Section "Metal Fabrications" for loose steel bearing plates and miscellaneous steel framing.

2. Division 9 Section "Painting" for surface preparation and priming requirements.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Engineer structural steel connections required by the Contract Documents to be selected or completed by the fabricator to withstand design loadings indicated.

B. Engineering Responsibility: Engage a fabricator who utilizes a qualified professional engineer to prepare calculations, Shop Drawings, and other structural data for structural steel connections.

1.4 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data for each type of product specified.

C. Shop Drawings detailing fabrication of structural steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.

2. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.

3. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify high-strength bolted slip-critical, direct-tension, or tensioned shear/bearing connections.

4. Include Shop Drawings signed and sealed by a qualified professional engineer responsible for their preparation.

D. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

E. Mill test reports signed by manufacturers certifying that their products, including the following, comply with requirements.

1. Structural steel, including chemical and physical properties.

2. Bolts, nuts, and washers, including mechanical properties and chemical analysis.

3. Shop primers.

4. Nonshrink grout.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed structural steel work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Fabricator Qualifications: Engage a firm experienced in fabricating structural steel similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to fabricate structural steel without delaying the Work.

1. Fabricator must participate in the AISC Quality Certification Program and be designated an AISC-Certified Plant as follows:

a. Category: Category I, conventional steel structures.

b. Fabricator shall be registered with and approved by authorities having jurisdiction.

C. Comply with applicable provisions of the following specifications and documents:

1. AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."

2. AISC's "Specification for Load and Resistance Factor Design of Single-Angle Members."

3. AISC's "Seismic Provisions for Structural Steel Buildings."

4. ASTM A 6 (ASTM A 6M) "Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use."

5. Research Council on Structural Connections' (RCSC) "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

6. Research Council on Structural Connections' (RCSC) "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Professional Engineer Qualifications: A professional engineer who is legally authorized to practice in the jurisdiction where Project is located and who is experienced in providing engi-

neering services of the kind indicated. Engineering services are defined as those performed for projects with structural steel framing that are similar to that indicated for this Project in material, design, and extent.

E. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code--Steel."

1. Present evidence that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver structural steel to Project site in such quantities and at such times to ensure continuity of installation.

B. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration.

1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.

2. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.7 SEQUENCING

A. Supply anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, templates, instructions, and directions, as required, for installation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Structural Steel Shapes, Plates, and Bars: As follows:

1. Carbon Steel: ASTM A 992 (ASTM A 992M) for steel shapes.

2. Carbon Steel: ASTM A36 (ASTM A 36M) for plates and bars.

B. Cold-Formed Structural Steel Tubing: ASTM A 500, Grade B.

C. Steel Pipe: ASTM A 53, Type E or S, Grade B.

1. Weight Class: Standard.

2. Finish: Black.

3. Finish: Black, except where indicated to be galvanized.

D. Anchor Rods, Bolts, Nuts, and Washers: As follows:

1. Headed Bolts: ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); carbon-steel, hex-head bolts; and carbon-steel nuts.

2. Washers: ASTM A 36 (ASTM A 36M).

E. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers.

1. Finish: Galvanized.

2. Direct-Tension Indicators: ASTM F 959, Type 325.

a. Finish: Galvanized.

F. High-Strength Bolts, Nuts, and Washers: ASTM A 490 (ASTM A 490M), Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers, uncoated.

1. Direct-Tension Indicators: ASTM F 959, Type 490, galvanized.

G. Welding Electrodes: Comply with AWS requirements.

H. Shear Connectors: ASTM 108, grades 1015 through 1020, headed studs type, cold finished carbon steel; AWS D1.1, Type B.

2.2 PRIMER

A. Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer with good resistance to normal atmospheric corrosion, complying with performance requirements of FS TT-P-664.

B. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds and repair painting galvanized steel, with dry film containing not less than 93 percent zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20.

2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, of consistency suitable for application, and a 30-minute working time.

2.4 FABRICATION

A. Fabricate and assemble structural steel in shop to greatest extent possible. Fabricate structural steel according to AISC specifications referenced in this Section and in Shop Drawings.

1. Mark and match-mark materials for field assembly.

2. Fabricate for delivery a sequence that will expedite erection and minimize field handling of structural steel.

3. Complete structural steel assemblies, including welding of units, before starting shop-priming operations.

4. Comply with fabrication tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded.

C. Finishing: Accurately mill ends of columns and other members transmitting loads in bearing.

D. Holes: Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members, as shown on Shop Drawings.

1. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame-cut holes or enlarge holes by burning. Drill holes in bearing plates.

2. Weld threaded nuts to framing and other specialty items as indicated to receive other work.

2.5 SHOP CONNECTIONS

A. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.

1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.

2. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent surface bleeding of back-side welding on exposed steel surfaces. Grind smooth exposed fillet welds 1/2 inch (13 mm) and larger. Grind flush butt welds. Dress exposed welds.

2.6 SHOP PRIMING

A. Shop prime steel surfaces, except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).

2. Surfaces to be field welded.

3. Surfaces to be high-strength bolted with slip-critical connections.

4. Surfaces to receive sprayed-on fireproofing.

5. Galvanized surfaces.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust, loose mill scale, and spatter, slag, or flux deposits. Prepare surfaces according to SSPC specifications as follows:

1. SSPC-SP 2 "Hand Tool Cleaning."

2. SSPC-SP 3 "Power Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

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

2. Apply 2 coats of shop paint to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from first.

D. Painting: Apply a 1-coat, nonasphaltic primer complying with SSPC's "Painting System Guide No. 7.00" to provide a dry film thickness of not less than 1.5 mils (0.038 mm).

2.7 SOURCE QUALITY CONTROL

Contractor shall engage an independent testing and inspecting agency to perform shop inspections and tests and to prepare test reports.

1. Testing agency will conduct and interpret tests and state in each report whether test specimens comply with or deviate from requirements.

2. Provide testing agency with access to places where structural steel Work is being fabricated or produced so required inspection and testing can be accomplished.

B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.

C. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.

D. Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

E. In addition to visual inspection, shop-welded connections will be inspected and tested according to AWS D1.1 and the inspection procedures listed below, at testing agency's option.

1. Liquid Penetrant Inspection: ASTM E 165.

2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before erection proceeds, and with the steel erector present, verify elevations of concrete and masonry bearing surfaces and locations of anchorages for compliance with requirements.

B. Do not proceed with erection until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC specifications referenced in this Section.

B. Base and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.

1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.

2. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.

3. Pack grout solidly between bearing surfaces and plates so no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.

a. Comply with manufacturer's instructions for proprietary grout materials.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

1. Maintain erection tolerances of architecturally exposed structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.

2. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service.

E. Splice members only where indicated.

F. Remove erection bolts on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.

G. Do not use thermal cutting during erection.

H. Finish sections thermally cut during erection equal to a sheared appearance.

I. Do not enlarge unfair holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

A. Install and tighten nonhigh-strength bolts, except where high-strength bolts are indicated.

B. Install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.

1. Comply with AISC specifications referenced in this Section for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.

D. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent surface bleeding of back-side welding on exposed steel surfaces. Grind smooth exposed fillet welds 1/2 inch (13 mm) and larger. Grind flush butt welds. Dress exposed welds.

3.5 FIELD QUALITY CONTROL

Contractor shall engage an independent testing and inspecting agency to perform field inspections and tests 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 requirements.

B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.

C. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.

D. Field-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

E. Field-bolted connections will be tested and inspected according to RCSC's "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1. Direct-tension indicator gaps will be verified to comply with ASTM F 959, Table 2.

F. In addition to visual inspection, field-welded connections will be inspected and tested according to AWS D1.1 and the inspection procedures listed below, at testing agency's option.

1. Liquid Penetrant Inspection: ASTM E 165.

2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.

3. Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T."

4. Ultrasonic Inspection: ASTM E 164.

G. In addition to visual inspection, field-welded shear connectors will be inspected and tested according to requirements of AWS D1.1 for stud welding and as follows:

1. Bend tests will be performed when visual inspections reveal either less than a continuous 360-degree flash or welding repairs to any shear connector.

2. Tests will be conducted on additional shear connectors when weld fracture occurs on shear connectors already tested, according to requirements of AWS D1.1.

3.6 CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting.

1. Apply by brush or spray to provide a minimum dry film thickness of 1.5 mils (0.038 mm).

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on structural steel are included in Division 9 Section "Painting."

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint according to ASTM A 780.

END OF SECTION 05120

SECTION 05310 - STEEL DECK

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. Composite floor deck.

B. Related Sections include the following:

1. Division 3 Section "Cast-in-Place Concrete" for concrete fill and reinforcing steel.

2. Division 5 Section "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.3 SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, deck openings, special jointing, accessories, and attachments to other construction.

C. Product Certificates: Signed by steel deck manufacturers certifying that products furnished comply with requirements.

D. Welding Certificates: Copies of certificates for welding procedures and personnel.

E. Product Test Reports: From a qualified testing agency indicating that each of the following complies with requirements, based on comprehensive testing of current products:

1. Mechanical fasteners.

F. Research/Evaluation Reports: Evidence of steel deck's compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed steel deck 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. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.

C. Source Limitations for Cellular Deck Floor Systems with Electrical Distribution: Obtain cellular floor deck units and compatible electrical components, such as preset inserts, activation kits, afterset inserts, service fittings, header ducts, and trench header ducts, from the same manufacturer. Electrical components are specified in Division 16 Section "Underfloor Raceway."

D. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

E. Fire-Test-Response Characteristics: Where indicated, provide steel deck units identical to those steel deck units tested for fire resistance per ASTM E 119 by a testing and inspection agency acceptable to authorities having jurisdiction.

1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.

2. Steel deck units shall be identified with appropriate markings of applicable testing and inspecting agency.

F. FM Listing: Provide steel roof deck evaluated by FM and listed in FM's "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

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

1. Steel Deck:

a. BHP Steel Building Products USA Inc.

b. Consolidated Systems, Inc.

c. Epic Metals Corp.

d. Marlyn Steel Products, Inc.

e. Nucor Corp.; Vulcraft Div.

f. Roof Deck, Inc.

g. United Steel Deck, Inc.

h. Verco Manufacturing Co.

i. Wheeling Corrugating Co.; Div. of Wheeling-Pittsburgh Steel Corp.

2.2 COMPOSITE FLOOR DECK

A. Composite Steel Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 29, the minimum section properties indicated, and the following:

1. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 (230), G90 (Z275) zinc coating.

2. Profile Depth: 2 inches (51 mm).

3. Design Uncoated-Steel Thickness: 0.0358 inch (0.92 mm).

4. Span Condition: Single.

2.3 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 (4.8 mm) minimum diameter.

D. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), not less than 0.0359-inch (0.91-mm) design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

E. Steel Sheet Accessories: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.

F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), of same material and finish as deck, and of thickness and recommended by SDI Publication No. 29 for overhang and slab depth.

G. Weld Washers: Uncoated steel sheet, shaped to fit deck rib 0.0747 inch (1.90 mm) thick, with factory-punched hole of 3/8-inch (9.5-mm) minimum diameter.

H. Shear Connectors: ASTM A 108, Grades 1010 through 1020 headed stud type, cold-finished carbon steel, AWS D1.1, Type B, with arc shields.

I. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.

J. Repair Paint: Lead- and chromate-free rust-inhibitive primer complying with performance requirements of FS TT-P-664.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 29, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels, if required to meet deflection limitations.

C. Locate decking bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

1. Align cellular deck panels for entire length of cell runs and align cells at ends of abutting panels.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to decking.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of decking, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

3.3 FLOOR DECK INSTALLATION

A. Fasten floor deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:

1. Weld Diameter: 5/8 inch (16 mm), nominal.

2. Weld Spacing: Weld edge ribs of panels at each support. Space additional welds an average of 12 inches (305 mm) apart, but not more than 18 inches (457 mm) apart.

3. Weld Washers: Install weld washers at each weld location.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of 1/2 of the span or 36 inches (910 mm), and as follows:

1. Mechanically fasten with self-drilling No. 10 (4.8-mm-) diameter or larger carbon-steel screws.

2. Mechanically clinch or button punch.

3. Fasten with a minimum of 1-1/2-inch- (38-mm-) long welds.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:

D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations, unless otherwise indicated.

E. Floor Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of decking. Weld cover plates at changes in direction of floor deck panels, unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

A. Contractor shall engage a qualified independent testing agency to perform field quality-control testing.

B. Field welds will be subject to inspection.

C. Remove and replace work that does not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.5 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05310

SECTION 05500 - METAL FABRICATIONS

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. Bridge edge angles.
2. Bridge Guard Rails and Handrails.
3. Bridge Curbs.
4. Bridge Trench Drains.
5. Steel framing and supports for ceiling hung toilet compartments.
6. Pipe Guard Rails.
7. Gratings.

B. Related Sections include the following:

1. Division 5 Section "Structural Steel" for structural steel framing system components.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Paint products.
2. Grout.

B. Shop Drawings: Detail fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

1. Provide templates for anchors and bolts specified for installation under other Sections.

C. Samples for Verification: For each type and finish of extruded nosing and tread.

D. Welding Certificates: Copies of certificates for welding procedures and personnel.

E. 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 PERFORMANCE REQUIREMENTS

A. Structural Performance of Hand Rails and Guard Railings: Provide hand rails and railings capable of withstanding structural loads required by ASCE 7 without exceeding the allowable design working stress of materials for handrails, railings, anchors, and connections.

1. Infill Area of Guards: Capable of withstanding a horizontal concentrated load of 200 lbf (890 N) applied to 1 sq. ft (0.09 sq.m) at any point in system, including panels, intermediate rails, balusters, or other elements composing infill area.

a. Load above need to be assumed to act concurrently with loads on top rails in determining stress on guards.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing metal fabrications 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.

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

1. AWS D1.1, "Structural Welding Code--Steel."

2. AWS D1.2, "Structural Welding Code--Aluminum."

3. AWS D1.3, "Structural Welding Code--Sheet Steel."

4. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.6 PROJECT CONDITIONS

A. Field Measurements: Where metal fabrications are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.7 COORDINATION

A. Coordinate installation of anchorages for metal fabrications. 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: For metal fabrications 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.

2.2 FERROUS METALS

A. Stainless steel, type 304, 18-8 mill finish.

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

C. Steel Pipe: ASTM A53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.

D. Grating: Comply with NAAMM MBS 531 "Metal Grating Manual."

E. Cast-in-Place Anchors in Concrete: Anchors of type indicated below, fabricated from corrosion- resistant materials capable of sustaining, without failure, the load imposed within a safety factor of 4, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

1. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47 (ASTM A 47M) malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153/A 153M.

F. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

2.3 PAINT

A. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664; selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Carboline 621; Carboline Company.

b. Aquapon Zinc-Rich Primer 97-670; PPG Industries, Inc.

c. Tneme-Zinc 90-97; Tnemec Company, Inc.

B. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

C. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers or cold-applied asphalt emulsions complying with ASTM D 1187.

2.4 FASTENERS

A. General: Provide Type 304 or 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, where built into exterior walls. Select fasteners for type, grade, and class required.

2.5 GROUT

A. Non shrink, Nonmetallic Grout: Factory-packaged, non-staining, non-corrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.6 FABRICATION, GENERAL

A. Shop Assembly: Pre-assemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for re-assembly and coordinated installation.

B. Shear and punch metals cleanly and accurately. Remove burrs.

C. Ease exposed edges to a radius of approximately 1/32-inch (1 mm), unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. 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.

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

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

G. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

H. Allow for thermal movement resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening up of joints, overstressing of compo-

nents, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

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

I. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.

J. Remove sharp or rough areas on exposed traffic surfaces.

K. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat head (countersunk) screws or bolts. Locate joints where least conspicuous.

2.7 ITEMS

A. Bridge Edge Angles: Fabricate components of ASTM A36 steel as detailed including past sleeves. Hot dip galvanized assembly after fabrication.

B. Guardrails: Fabricate components of stainless steel as detailed.

C. Bridge Curbs: Fabricate components of stainless steel as detailed.

D. Trench Drains

1. General: Provide drains as detailed similar and equal to ACO Polymer Products, Inc. Type K 1005, general purpose trench drains.

E. Toilet partition supports.

1. Fabricate as detailed on the drawings.

F. Pipe Guardrails: Fabricate from 1 1/2” [38] steel pipe, weld and grind all joints. Provide rails with angle brackets for “face of wall” mounting and similar rails for other mountings.

G. Gratings: Size grating to support 100 lb/sq.ft (445 M). Provide support angles at existing equipment; cut grating to fit neatly around piping.

H. Loose steel inlets:

1. Fabricate loose structural-steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.

2. Weld adjoining members together to form a single unit where indicated.

3. Size loose lintels to provide bearing length at each side of openings equal to one-twelfth of clear span, but not less than 8 inches (200 mm), unless otherwise indicated.

4. Galvanize loose steel lintels located in exterior walls.

2.8 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.

2.9 STAINLESS-STEEL FINISHES

A. Remove tool and die marks and stretch lines or blend into finish.

B. Grid and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

C. Dull satin finish: No. 6

D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.10 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:

1. ASTM A 123/A 123M, for galvanizing steel and iron products.

B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:

1. Exteriors (SSPC Zone 1B), SSPC-SP6/NACE No. 3, « Commercial Blast Cleaning. »

2. Interiors (SSPC Zone 1A): SSPC-SP 3, “Power Tool Cleaning.”

C. Shop Priming: Apply shop primer to uncoated surfaces to metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, “Paint Application Specification No.1: Shop, Field, and Maintenance Painting of Steel,” for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction. Include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts; lag bolts, wood screws, and other connectors.

B. 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 surface 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 surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

E. 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.

F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

G. 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 non-shrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use non-shrink, nonmetallic grout in exposed locations, unless otherwise indicated.

2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

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, if any.

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

3.3 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed 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 9 Section "Painting."

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

END OF SECTION 05500

SECTION 06100 - ROUGH CARPENTRY

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. Wood furring, grounds, nailers, plywood sheathing, blocking, cants and curbs.

1.3 DEFINITIONS

A. Rough Carpentry: Carpentry work not specified in other Sections and not exposed, unless otherwise specified.

1.4 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. 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 American Lumber Standards Committee's (ALSC) Board of Review.

C. Wood treatment data as follows, including chemical treatment manufacturer's instructions for handling, storing, installing, and finishing treated materials:

1. For each type of preservative-treated wood product, include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.

2. For waterborne-treated products, include statement that moisture content of treated materials was reduced to levels indicated before shipment to Project site.

D. Warranty of chemical treatment manufacturer for each type of treatment.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Keep materials under cover and dry. Protect from weather and contact with damp or wet surfaces. Stack lumber, plywood, and other panels. Provide for air circulation within and around stacks and under temporary coverings.

1. For lumber and plywood pressure treated with waterborne chemicals, place spacers between each bundle to provide air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Wood-Preservative-Treated Materials:

a. Baxter: J. H. Baxter Co.
b. Chemical Specialties, Inc.
c. Continental Wood Preservers, Inc.
d. Hickson Corp.
e. Hoover Treated Wood Products, Inc.
f. Osmose Wood Preserving, Inc.

2.2 LUMBER, GENERAL

A. Lumber Standards: Comply with DOC PS 20, "American Softwood Lumber Standard," and with applicable grading rules of inspection agencies certified by ALSC's Board of Review.

B. Inspection Agencies: Inspection agencies, and the abbreviations used to reference them, include the following:

1. SPIB - Southern Pine Inspection Bureau.

C. Grade Stamps: Provide lumber with each piece factory marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.

D. 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.

1. Provide dressed lumber, S4S, unless otherwise indicated.

2. Provide lumber with 15 percent maximum moisture content at time of dressing for 38-mm actual thickness or less, unless otherwise indicated.

2.3 WOOD-PRESERVATIVE-TREATED MATERIALS

A. General: Where lumber or plywood is indicated as preservative treated or is specified to be treated, comply with applicable requirements of AWPA C2 (lumber) and AWPA C9 (plywood). Mark each treated item with the Quality Mark Requirements of an inspection agency approved by ALSC's Board of Review.

1. Do not use chemicals containing chromium or arsenic.

B. Pressure treat aboveground items with waterborne preservatives to a minimum retention of 4.0 kg/cu. m. After treatment, kiln-dry lumber and plywood to a maximum moisture content of 19 and 15 percent, respectively. Treat indicated items and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.

2.4 MISCELLANEOUS LUMBER

A. General: Provide lumber for support or attachment of other construction, including rooftop equipment curbs and support bases, cant strips, bucks, nailers, blocking, furring, grounds, stripping, and similar members.

B. Fabricate miscellaneous lumber from dimension lumber of sizes indicated and into shapes shown.

C. Moisture Content: 19 percent maximum for lumber items not specified to receive wood preservative treatment.

D. Grade: For dimension lumber sizes, provide No. 3 or Standard grade lumber per ALSC's NGRs of any species. For board-size lumber, provide No. 3 Common grade per NELMA, NLGA, or WWPA; No. 2 grade per SPIB; or Standard grade per NLGA, WCLIB or WWPA of any species.

2.5 CONCEALED, PERFORMANCE-RATED STRUCTURAL USE PANELS

A. General: Where structural-use panels are indicated for the following concealed types of applications, provide APA performance-rated panels complying with requirements designated under each application for grade, span rating, exposure durability classification, and edge detail (where applicable).

1. Thickness: Provide panels meeting requirements specified but not less than thickness indicated.

2. Edge Detail: Square

3. Wall sheathing: APA-rated structural I sheathing.

4. Exposure Durability classification: Exterior.

2.6 FASTENERS

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

1. Provide fasteners with a hot-dip zinc coating per ASTM A 153 or of Type 304 stainless steel.

B. Nails, Wire, Brads, and Staples: FS FF-N-105.

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

D. Wood Screws: ASME B18.6.1.

E. Lag Bolts: ASME B18.2.3.8M.

F. Bolts: Steel bolts complying with ASTM F 569, Property Class 4.6; with ASTM A 563M hex nuts and, where indicated, flat washers.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Discard units of material with defects that impair quality of rough carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.

B. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted.

C. Fit rough carpentry to other construction; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction.

D. Apply field treatment complying with AWPA M4 to cut surfaces of preservative-treated lumber and plywood.

E. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated.

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

3.2 WOOD GROUNDS, NAILERS, BLOCKING, AND SLEEPERS

A. Install wood grounds, nailers, blocking, and sleepers where shown and where required for screeding or attaching other work. Form to shapes shown and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.

C. Install permanent grounds of dressed, preservative-treated, key-beveled lumber not less than 38 mm wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

END OF SECTION 06100

SECTION 06402 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Plastic-laminate cabinets.
2. Plastic-laminate countertops.

B. Related Sections include the following:

1. Division 6 Section "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork 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 SUBMITTALS

A. Product Data: For each type of product indicated, including cabinet hardware and accessories.

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

B. 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 wiring and other items installed in architectural woodwork.
4. Apply WIC-certified compliance label to first page of Shop Drawings.

C. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available for each type of material indicated.

1. Plastic laminates.

D. Product Certificates: Signed by manufacturers of woodwork certifying that products furnished comply with requirements.

E. 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.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed architectural woodwork 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. Fabricator Qualifications: A firm experienced in producing architectural woodwork similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

C. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork, construction, finishes, and other requirements.

1. Provide AWI Quality Certification Program [labels] [certificate] indicating that woodwork complies with requirements of grades specified.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

1.6 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.

1.7 PROJECT CONDITIONS

A. 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.

1.8 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.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide materials that comply with requirements of the AWI quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.

B. Wood Products: Comply with the following:

1. Hardboard: AHA A135.4.
2. Medium-Density Fiberboard: ANSI A208.2, Grade MD-Exterior Glue.
3. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
4. Softwood Plywood: DOC PS 1, Medium Density Overlay.
5. Hardwood Plywood and Face Veneers: HPVA HP-1.

C. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated, or if not indicated, as required by woodwork quality standard.

D. Adhesive for Bonding Plastic Laminate: Resorcinol.

1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.2 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.

B. Hardware Standard: Comply with BHMA A156.9 for items indicated by referencing BHMA numbers or items referenced to this standard.

C. Butt Hinges: 2-3/4-inch (70-mm), 5-knuckle steel hinges made from 0.095-inch- (2.4-mm-) thick metal, and as follows:

1. Semiconcealed Hinges for Overlay Doors: BHMA A156.9, B01521.

D. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, [100] [135] [170] degrees of opening[, self-closing].

E. Back-Mounted Pulls: BHMA A156.9, B02011.

F. Wire Pulls: Back mounted, [4 inches (100 mm) long, 5/16 inches (8 mm) in diameter.

G. Catches: Magnetic catches, BHMA A156.9, B03141.

H. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.

I. Shelf Rests: BHMA A156.9, B04013.

J. Drawer Slides: Side-mounted, full-extension, zinc-plated steel drawer slides with steel ball bearings, BHMA A156.9, B05091, and rated for the following loads:

1. Box Drawer Slides: 100 lbf (440 N).
2. File Drawer Slides: 200 lbf (890 N).
3. Pencil Drawer Slides: 45 lbf (200 N).

K. Door Locks: BHMA A156.11, E07121.

L. Drawer Locks: BHMA A156.11, E07041.

M. Grommets for Cable Passage through Countertops: 2-inch (51-mm) black, molded-plastic grommets and matching plastic caps with slot for wire passage.

N. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

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

2.3 INSTALLATION 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. Handrail/Bumper Rail Brackets: Pairs of extruded-aluminum channels; one for fastening to back of rail and one for fastening to face of wall. They are then assembled in overlapping fashion and fastened together top and bottom with self-tapping screws. Sized to provide 1-1/2-inch (38-mm) clearance between handrail and wall.

2.4 FABRICATION, GENERAL

A. Interior Woodwork Grade: Provide custom grade interior woodwork complying with the referenced quality standard.

B. 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.

C. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:

1. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members 3/4 Inch (19 mm) Thick or Less: 1/16 inch (1.5 mm).
2. Edges of Rails and Similar Members More Than 3/4 Inch (19 mm) Thick: 1/8 inch (3 mm).
3. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members and Rails: 1/16 inch (1.5 mm).

D. Complete fabrication, including assembly, [finishing,] 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.

E. 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.

2.5 PLASTIC-LAMINATE CABINETS

A. Quality Standard: Comply with AWI Section 400 requirements for laminate cabinets.

B. Grade: custom.

C. AWI Type of Cabinet Construction: Flush overlay.

D. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:

1. Horizontal Surfaces Other Than Tops: [HGS] [HGL].
2. Vertical Surfaces: VGS.
3. Edges: VGS.

E. Materials for Semiexposed Surfaces: Provide surface materials indicated below:

1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, Grade VGS.
2. Drawer Sides and Backs: Solid-hardwood lumber
3. Drawer Bottoms: Hardwood plywood.

F. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. Match Architect's sample.
2. Provide selections from laminate manufacturer's full range of colors and finishes in the following categories:

a. Solid colors.
b. Solid colors with core same color as surface.
c. Wood grains.
d. Patterns.

G. Provide dust panels of 1/4-inch (6.4-mm) plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

2.6 PLASTIC-LAMINATE COUNTERTOPS

A. Quality Standard: Comply with AWI Section 400 requirements for high-pressure decorative laminate countertops.

B. Grade: Custom.

C. High-Pressure Decorative Laminate Grade: HGS.

D. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. Provide selections from manufacturer's full range of colors and finishes in the following categories:

a. Solid colors.
b. Solid colors with core same color as surface.
c. Wood grains.
d. Patterns.

E. Grain Direction: Parallel to cabinet fronts.

F. Edge Treatment: Same as laminate cladding on horizontal surfaces.

G. Core Material: Particleboard or medium-density fiberboard.

PART 3 - EXECUTION

3.1 PREPARATION

A. Condition woodwork to average prevailing humidity conditions in installation areas before installation.

B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

A. Quality Standard: Install woodwork to comply with AWI Section 1700 for the same grade specified in Part 2 of this Section for type of woodwork involved.

B. 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).

C. Scribe and cut woodwork to fit adjoining work, and refinish cut surfaces and repair damaged finish at cuts.

D. 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.

E. 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. Maintain veneer sequence matching of cabinets with transparent finish.
3. 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 sheet metal screws through metal backing or metal framing behind wall finish or toggle bolts through metal backing or metal framing behind wall finish.

F. Countertops: 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.

3.3 ADJUSTING AND CLEANING

A. 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.

B. Clean, lubricate, and adjust hardware.

C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 06402

SECTION 07160 - BITUMINOUS DAMPPROOFING

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. Cold-applied, cut-back asphalt dampproofing.

1.3 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product data for each type of product specified, including data substantiating that materials comply with requirements for each dampproofing material specified. Include recommended method of application, recommended primer, number of coats, coverage or thickness, and recommended protection course.

1. Certification by dampproofing manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed bituminous dampproofing similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Single-Source Responsibility: Obtain primary dampproofing materials and primers from one source and by a single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

1.5 PROJECT CONDITIONS

A. Substrate: Proceed with dampproofing only after substrate construction and penetrating work have been completed.

B. Weather Limitations: Proceed with dampproofing only when existing and forecasted weather conditions will permit work to be performed according to manufacturer's recommendations and warranty requirements.

C. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has thoroughly cured.

PART 2 - PRODUCTS

2.1 BITUMINOUS DAMPPROOFING

A. General: Provide products recommended by manufacturer for designated application.

B. Cold-Applied, Cut-Back Asphalt Dampproofing: Asphalt and solvent compound mixed to a smooth, uniform consistency to provide a firm, moisture-resistant, vapor-resistant, elastic coating recommended by the manufacturer for dampproofing use when applied according to the manufacturer's instructions.

1. Semimastic Grade: Asphalt roof coating, consisting of an asphalt base with petroleum solvents and mineral stabilizers, complying with ASTM D 4479, Type I.

2.2 MISCELLANEOUS MATERIALS

A. Primer: Asphalt primer complying with ASTM D 41, for asphalt-based dampproofing.

B. Glass Fabric: Woven glass fabric, treated with asphalt, complying with ASTM D 1668, Type I.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrate of projections and substances detrimental to work; comply with recommendations of prime materials manufacturer.

B. Fill voids, seal joints, and apply bond breakers, if any, as recommended by prime materials manufacturer, with particular attention at construction joints.

C. Install separate flashings and corner protection stripping, as recommended by prime materials manufacturer, where indicated to precede application of dampproofing. Comply with details shown and with manufacturer's recommendations. Pay particular attention to requirements at building expansion joints, if any.

D. Prime substrate as recommended by prime materials manufacturer.

E. Protection of Other Work: Do not allow liquid and mastic compounds to enter and clog drains and conductors. Prevent spillage and migration onto other surfaces of work by masking or otherwise protecting adjoining work.

3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's recommendations except where more stringent requirements are indicated and where Project conditions require extra precautions to ensure satisfactory performance of work.

B. Application: Apply dampproofing to the following surfaces.

1. Exterior surface of inside wythe of double-wythe, exterior masonry walls above grade, to prevent water-vapor penetration through the wall.

C. Cold-Applied Asphalt Dampproofing: Provide only emulsified asphalt materials.

D. Reinforcement: At changes in plane or where otherwise shown as "reinforced," install lapped course of glass fabric in first coat of dampproofing compound before it thickens.

3.3 COLD-APPLIED, CUT-BACK ASPHALT DAMPPROOFING

A. Semimastic Grade: Brush or spray apply a coat of dampproofing at a rate of 5 gal./100 sq. ft. (2 L/sq. m), to produce a uniform, dry-film thickness of not less than 30 mils (0.8 mm).

3.4 PROTECTION AND CLEANING

A. Protect exterior, below-grade dampproofing membrane from damage until backfill is completed. Remove overspray and spilled materials from surfaces not intended to receive dampproofing.

3.5 INSTALLATION OF PROTECTION COURSE

A. General: Where indicated, install protection course of type indicated over completed-and-cured dampproofing treatment. Comply with dampproofing materials manufacturer's recommendations for method of support or attaching of protection materials. Support with spot application of trowel-grade mastic where not otherwise indicated.

END OF SECTION 07160

SECTION 07270 - FIRESTOPPING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Scope: Provide U.L. listed firestopping materials, systems, and/or devices for the following:

1. Penetrations through fire-resistance rated floor and roof construction including both empty openings and openings containing cables, pipes, ducts, conduits, and other penetrating items.

2. Penetrations through fire-resistance rated walls and partitions including both empty openings and openings containing cables, pipes, ducts, conduits, and other penetrating items.

3. Penetrations through smoke barriers and construction enclosing compartmentalized areas involving both empty openings and openings containing penetrating items.

4. Sealant joints in fire-resistance rated construction.

B. Design Requirements

1. Fire-rated construction: Maintain barrier and structural fire resistance ratings including resistance to cold smoke at all penetrations, connections with other surfaces or types of construction, at separations required to permit building movement and sound or vibration absorption, and at other construction gaps.

2. Smoke barrier construction: Maintain barrier or other structural resistance to cold smoke at all penetrations, connection with other surfaces and types of construction and at all separations required to permit building movement and sound or vibration absorption, and at other construction gaps.

3. All firestopping materials, systems, and devices must be listed by Underwriter's Laboratories, Inc.

C. Related Sections and Divisions:

1. Refer to these specifications for related guidance:

a. Division 3 Section "Cast-In-Place Concrete"

b. Division 4 Section "Unit Masonry"

c. Division 7 Section "Building Insulation

d. Division 7 Section "Joint Sealants"

e. Division 15 sections specifying ducts and pipe penetrations

f. Division 16 sections specifying cable and conduit penetrations

1.2 QUALITY ASSURANCE

A. Installer's qualifications: The installer must be experienced in installation or application of systems similar in complexity to those required for this project, plus the following:

1. Acceptance to or licensed by manufacturer, state, or local authority;

2. At least 2 years experience with systems; and

3. Have a record of successful completion of at least 5 comparable scale projects using this system.

B. Materials shall have been tested to provide a fire rating at least equal to that of the construction.

C. Guarantee: Submit copies of written guarantee agreeing to repair or replace joint sealers which fail in joint adhesion, co-adhesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, or general durability or appear to deteriorate in any other manner not clearly specified by submitted manufacturer's data as an inherent quality of the material for the exposure indicated. The guarantee period shall be one year from date of substantial completion.

D. Codes and Standards: Provide firestopping listed in the U.L. Fire Resistance Directory as follows:

1. Through-penetration firestop devices (XHCR)
2. Fire resistance ratings (BXUV)
3. Through-penetration firestop systems (XHEZ)
4. Fill, void, or cavity material (XHHW)

E. Other References: American Society for Testing and Material Standards

1. ASTM E-814 - 88; Standard Test Method for Fire Tests of Through Penetration Firestops.

1.3 DEFINITIONS

A. Assembly: Particular arrangement of materials specific to given type of construction described or detailed in referenced documents.

B. Barriers: Time rated fire walls, smoke barrier walls, time rated ceiling/floor assemblies and structural floors.

C. Firestopping: Methods and materials applied in penetrations and unprotected openings to limit the spread of heat, fire gases, and smoke.

D. Penetration: Opening or foreign material passing through or into barrier or structural floor such that full thickness of rated material is not obtained.

E. Construction Gap: Gaps between adjacent sections of walls, exterior walls, at wall tops between the top of wall and ceiling, and structural floors or roof decks; and gaps between adjacent sections of structural floors.

F. System: Specific products and applications, classified and numbered by Underwriter's Laboratories, Inc. to close specific barrier penetrations.

G. Sleeve: Metal fabrication or pipe section extending through the thickness of the barrier and used to permanently guard the penetration. Sleeves are described as part of penetrating systems in other sections and may or may not be required.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's specifications and technical data including the following:

1. Detailed specification of construction and fabrication.
2. Manufacturer's installation instructions.
3. Catalog cut listing system components.

B. Shop Drawings: Indicate dimensions, description of materials and finishes, general construction, specification modifications, component connections, anchorage methods, hardware, and installation procedures, plus the following specific requirements:

1. Details of each proposed assembly identifying intended products and applicable U.L. system number or U.L. classified devices.

2. Manufacturer or manufacturer's representative shall provide qualified engineering judgements and drawings relating to non-standard applications as needed.

C. Quality Control Submittals

1. Submit a statement of qualifications.

D. Applicators' Qualifications Statement

1. List past projects indicating required experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging and Shipping

1. Deliver products in original unopened packaging with legible manufacturer's identification.

2. Coordinate delivery with scheduled installation date, allow minimum storage at site.

B. Storage and Protection: Store materials in a clean, dry, ventilated location. Protect from soiling, abuse, moisture, high temperatures, and freezing where required. Follow manufacturer's instructions.

1.6 PROJECT CONDITIONS

A. Existing Conditions

1. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.

2. Proceed with installations only after penetrations of the substrate and supporting brackets have been installed.

B. Environmental Requirements

1. Furnish adequate ventilation if using solvent.

2. Furnish forced air ventilation during installation if required by manufacturer.

3. Keep flammable materials away from sparks or flame.

4. Provide masking and drop cloths to prevent contamination of adjacent surfaces by firestopping materials.

5. Comply with manufacturer's recommendations for temperature and humidity conditions before, during, and after installation of firestopping.

PART 2- PRODUCTS

2.1 PRODUCT SELECTION

A. Provide firestopping materials, systems, and devices that are suitable for the application and are U.L. listed for such an application.

PART 3 - EXECUTION

3.1 EXAMINATION AND CLEANING

A. Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.

1. Verify barrier penetrations are properly sized and in suitable condition for application of materials.

2. Do not proceed until unsatisfactory conditions have been corrected.

B. Cleaning: Clean surfaces to be in contact with penetration seal materials of dirt, grease, oil, loose materials, rust, or other substances that may affect proper fitting, adhesion, or the required fire resistance.

3.2 INSTALLATION

A. Install penetration seal materials in accordance with printed instructions of the U.L. Fire Resistance Directory and in accordance with manufacturer's instructions.

B. Seal holes or voids made by penetrations to ensure an effective smoke barrier.

C. Where floor openings without penetrating items are more than four inches in width and subject to traffic or loading, install firestopping materials capable of supporting same loading as the floor.

D. Protect materials from damage on surfaces subject to traffic.

E. Place firestopping in annular space around fire dampers before installation of damper's anchoring flanges which are installed in accordance with the fire damper manufacturer's recommendations.

F. Where large openings are created in walls or floors to permit installation of pipes, ducts, cable trays, bus ducts or other items, close unused portions of the opening with firestopping material tested for the application.

G. Install smoke stopping as specified for firestopping.

H. Where rated walls are constructed with horizontally continuous air space, double width masonry, or double stud frame construction, provide vertical, 12 inch wide fiber dams for full thickness and height of air cavity at maximum 15 foot intervals.

3.3 FIELD QUALITY CONTROL

A. Examine penetration-sealed areas to ensure proper installation before concealing or enclosing areas.

B. Keep areas of work accessible until inspection by applicable code authorities.

C. Perform, under this section, patching and repairing of firestopping caused by cutting or penetration by other trades.

3.4 ADJUSTING AND CLEANING

A. Clean up spills of liquid components.

B. Neatly cut and trim materials as required.

C. Remove equipment, materials, and debris, leaving the area in undamaged, clean condition.

END OF SECTION 07270

SECTION 07552 - SBS-MODIFIED BITUMINOUS MEMBRANE ROOFING

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. Removal of existing roofing and related construction.
2. SBS modified bituminous membrane permanent roofing.
3. Roof insulation.

B. Related Sections include the following:

1. Division 2 Section "Selective Demolition" for general requirements for demolition of existing roofing and associated items.
2. Division 6 Section "Rough Carpentry" for wood nailers, cants, curbs, and blocking.
3. Division 7 Section "Manufactured Roof Specialties"copings, gutter and down spouts.

1.3 DEFINITIONS

A. Roofing Terminology: Refer to ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.

B. Design Uplift Pressure: The uplift pressure, calculated according to procedures in SPRI's "Wind Load Design Guide for Fully Adhered and Mechanically Fastened Roofing Systems," before multiplication by a safety factor.

C. Factored Design Uplift Pressure: The uplift pressure, calculated according to procedures in SPRI's "Wind Load Design Guide for Fully Adhered and Mechanically Fastened Roofing Systems," after multiplication by a safety factor.

1.4 PERFORMANCE REQUIREMENTS

A. General: Provide installed roofing membrane and base flashings that remain watertight; do not permit the passage of water; and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.

1. Requirements under this heading (Performance Requirements) apply to both temporary and permanent roofing.

2. Provide installed roofing membrane and base flashings that remain watertight; do not permit the passage of water; and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.

B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.

C. FMG Listing: Provide roofing membrane, base flashings, and component materials that comply with requirements in FMG 4450 and FMG 4470 as part of a roofing system and that are listed in FMG's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FMG markings.

1. Fire/Windstorm Classification: Class 1A. Required uplift pressure in indicted on the drawings.
2. Hail Resistance: MH.

D. Roofing System Design: Provide roofing systems that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist the factored design uplift pressures calculated according to SPRI's "Wind Load Design Guide for Fully Adhered and Mechanically Fastened Roofing Systems." Installed roofing and insulation shall be capable of resisting the following forces according to recommendations in FMG Loss Prevention Data Sheet 1-49. The required wind zone is indicated on the drawings.

1. Wind Zone 1: For velocity pressures of 10 to 20 lbs/sq.ft (0.48 to 0.96 kPa): 40-lbf/sq.ft. (1.92-kPa) perimeter uplift force, 60-lbf/sq.ft (2.87-kPa) corner uplift force, and 20-lbf/sq.ft. (0.96-kPa) outward force.

E. Design Review: Prior to submitting a bid, the Contractor and the proposed roofing manufacturer shall review the roofing and underlying supporting deck designs indicated. After this review, the Contractor shall recommend changes to the design, if any, necessary to ensure that the specified performance requirements will be met, that the required warranties will be issued, and that the installed roofing will comply with applicable code requirements. Recommended design changes shall be submitted fourteen (14) days prior to the bid, for approval by the Government. Proposed increases in the Contract Sum for design changes proposed after bid submission to ensure code, warranty, or structural compliance will not be accepted.

F. The building is occupied. Protect the building at all times from intrusion of rain into the building. Sequence the work, remove only the amount of existing materials as can be covered by the new roofing system in one day. Have available temporary covers such as large EPDM sheets to protect the building from unanticipated inclement weather. Do not begin existing roof removal work and expose areas of building to weather on days when rain is anticipated. Do not begin new roofing work on days when inclement weather is forecasted later in the day. Completely protect new construction from water intrusion due to inclement weather at the end of each workday.

G. Do not proceed with existing roofing removal until all possible preparatory work is complete.

H. Note that the existing roofing is known to have been leaking. Water will be found within the existing roofing system including within the roof insulation, and on the existing structural decks. Allow for this, and include work necessary to dry the existing structural deck before proceeding with the new roofing work.

1.5 SUBMITTALS

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

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

1. Base flashings, cants, and membrane terminations.
2. Tapered insulation, including slopes.
3. Crickets, saddles, and tapered edge strips, including slopes.
4. Insulation fastening patterns.

C. Samples for Verification: For the following products:

1. 12-by-12-inch (300-by-300-mm) square of base-ply sheet.
2. 12-by-12-inch (300-by-300-mm) square of mineral-granule-surfaced roofing membrane cap sheet, of color specified.
3. 12-by-12 inch (300 by 300 mm) square of each type roof insulation.
4. Six insulation fasteners of each type, length, and finish.

D. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing system.

E. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in “Performance Requirements” Article.

1. Submit evidence of meeting performance requirements.

F. Qualification Data: For Installer and manufacturer.

1. For demolition firm.

2. For installer and manufacturer of each type roofing.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of roofing system.

I. Research/Evaluation Reports: For components of roofing system.

J. Proposed Dust-Control and Noise-Control Measures during Demolition Procedures: Submit statement or drawing that indicated the measures proposed for use, proposed locations, and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate.

K. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure that Owner’s on-site operations are uninterrupted.

2. Interruption of utility services, if necessary.

3. Coordination for shut-off, capping and continuation of utility services.

4. Use of stairs.

5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed work.

L. Pre-demolition Photographs or Videotape: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations. Submit before work begins.

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

N. Warranties: Special warranties specified in this section.

O. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.

1.6 QUALITY ASSURANCE

A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this project.

B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Demolition Standards: Comply with ANSI A10.6 and NFPA 241.

D. Roofing Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's warranty.

E. Manufacturer Qualifications: A qualified manufacturer that has UL listing and FMG approval roofing system identical to that used for this Project.

F. Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.

F. Source Limitations: Obtain components for roofing system from or approved by roofing system manufacturer, in accordance with roofing manufacturer's requirements.

G. Fire-Test-Response Characteristics: Provide roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, FMG, or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.

1. Exteerior Fire-Test Exposure: Class ASTM E 108, for application and roof slopes indicated.

I. Predemolition Conference: Conduct conference at project site to comply with requirements in division 1.

1. Inspect and discuss condition of construction to be selectively demolished.

2. Review structural load limitations of existing structure.

3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.

4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.

J. Preliminary Roofing Conference: Before beginning roofing installation, conduct a preliminary roofing conference at Project site. Comply with the requirements for pre-installation conferences in Division 1. During this conference, review methods and procedures related to roof deck construction and roofing system including, but not limited to, the following:

1. Meet with COR, testing and inspecting agency representative, roofing installer, roofing system manufacturer's representativ and installers whose work interfaces with or affects roofing including installers of roof accessories and roof-mounted equipment.

2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.

3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening. Review structural loading limitations of roof deck during and after roofing. Repair deck substrates where necessary.

5. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.

6. Review governing regulations and requirements for insurance and certificates if applicable.

7. Review temporary protection requirements for roofing system during and after installation.

8. Review roof observation and repair procedures after roofing installation.

K. Preinstallation Conference: Conduct a pre-installation roofing conference at project site "Project Management and Coordination." Review methods and procedures related to roofing system including, but not limited to, the following:

1. Meet with COR, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck support installer, deck installer, and installers whose work interfaces with or affects roofing including installers of roof accessories and roof-mounted equipment.

2. Review methods and procedures related to roof deck construction and roofing installation, including manufacturer's written instructions.

3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.

5. Review governing regulations and requirements for insurance and certificates if applicable.

6. Review temporary protection requirements for roofing system during and after installation.

7. Review roof observation and repair procedures after roofing installation.

1.7 DELIVERY, STORAGE, AND HANDLING

B. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storage.

C. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

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

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

1.8 PROJECT CONDITIONS

A. Weather Limitations:

1. Proceed with selective demolition only when existing and forecasted weather conditions permit the new roofing system to be installed according to manufacturer's written instructions and warranty requirements prior to precipitation on the exposed roof deck.

B. Owner will occupy portions of the building immediately adjacent to and beneath selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted. Provide not less than 72 hours' written notice to Owner, of activities that will affect Owner's operations.

C. Maintain access to exiting walkway, corridors and other adjacent occupied or used facilities.

1. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from authorities having jurisdiction.

D. Owner assumes no responsibility for condition of areas to be selectively demolished.

1. Contractor shall not rely on details or statements related to existing conditions, whether in the Contract Documents or otherwise presented, but shall make its own test cuts to determine existing conditions prior to submitting a bid. Contractor shall patch its test cuts in a manner that is satisfactory to the owner to prevent damage to the building or its contents prior to beginning the Work. After that, Contractor shall be responsible for existing conditions, and request for additions to the Contract Sum due to unanticipated existing material thickness, unexpected materials, or difficulties in removing existing roofing or other construction will not be accepted. Owner will maintain conditions existing at time of Contractor's inspection and testing for bidding purpose, so far as is practicable, until date of Notice to Proceed.

E. Hazardous materials: It is not expected that hazardous materials will be encountered in the Work.

1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify the Owner. Owner will remove hazardous materials under a separate contract.

F. Storage or sale removed items or materials on-site will not be permitted.

G. Fire service: Maintain fire-protection facilities in service during selective demolition operations.

1.9. SPECIAL SAFETY REQUIREMENTS

A. All contractors shall be licensed and insured in the geographic area where they will conduct business. The work shall be properly prepared before the welding process begins and weather conditions shall be favorable. Procedures and equipment shall comply with all applicable code requirements, including guidelines mandated by the Occupational Safety and Health Administration ("OSHA").

B. Ensure that all mechanics or applicators involved with the application of the heat welded modified bitumens are properly trained in application and equipment handling and safety measures. Verify that all roofing applicators involved with open flame application maintain and carry a valid Certified Roofing Torch Applicator ("CERTA") card as evidence of proper training. Further, the General Contractor and jobsite superintendents shall be knowledgeable pf the proper and necessary safety precautions applicable to heat welded roofing products.

C. All mechanics or applicators shall carry, review, understand, and adhere to the safety information and guidelines contained in "Torch Applied/Do's and Dont's" as published and supplied by the Asphalt Roofing Manufactures Association. "ARMA"). which may be supplemented or amended, as well as the ARMA/NRCA "Guide to Torch Safety on Modified Bitumen" video tape. These are available from ARMA ar: ARMA 4041 Powder Mill Road, Suite 404, Calverton, MD 20705-3016, PHONE: (301) 348-2002. Review these safety procedures and installation practices prior to commencement of application procedures.

D. Written notice shall be given to the local fire department where required and any required or necessary permits shall be obtained. Even if not required, give notice to the fire department, particularly when using LP gas.

E. Ensure that all roofing applicators wear adequate protective equipment, including non-synthetic long-sleeved shirt, boots, long pants with no cuffs that extend over the top of the boot heat-resistant gloves, safety glasses, and a face shield during application.

F. Never heat weld directly to or near combustible materials or surfaces. Take extra care to identify all potentially combustible and flammable aspects of a building's use and design. Be aware of insulation type, parapet walls, curbs, cants, wood, edge strips, expansion joints, electrical wires and conduits, gas lines, chemicals grease, oil, vapors, exhausts, spills or other materials that could ignite. Combustible materials present on a roof shall be moved and materials that are not movable shall be protected form the heat weld process and other fire hazards with fire blankets or shields. Identify similar materials on adjoining buildings and exercise proper precautions.

F. Do not heat weld near or into vents, openings or cracks around the edges, corners, voids, or other penetra tions in the building near any rooftop equipment. Shut off fans and cover openings.

H. Do not leave lighted torches unattended.

I. Use only equipment that is specifically designed for heat welded roofing applications and be sure the equipment is listed by a nationally recognized independent testing laboratory. The equipment shall be operated in accordance with the manufacturer's instructions and in accordance with all applicable codes and regulations. All mechanics shall be properly trained and familiar with all safety precautions in the use and handling of tanks, regulators and LP gas. Be familiar with National Fire Protection Association ("NFPA") 58 " Standard for the Storage and Handling of Liquified Petroleum Gases" and appropriate publications of the National Propane Gas Association, 1600 Eisenhower Lane, Suite 100, Lisle, IL 60532, Phone (630) 515-0600 and the National Fire Protection Association, 11 Tracy Drive, Avon, MA 02322, Phone (800) 344-3555. Do not work in areas where LP Gas can accumulate. Proper ventilation in accordance with OSHA and the National Institute for Occupational Safety and Health ("NIOSH") is required. Ensure that all equipment is in good working condition and inspected daily.

J. Maintain at least one fully charged 20-lb. (minimum) ABC-type dry chemical fire extinguisher for each

roofing mechanic on the project and have more available near the application area (within 50 feet based on jobsite conditions). Roofing mechanics shall have fire extinguisher use training at least annually per OSHA 29 CFR1910.157.

K. Follow fire protection and prevention procedures mandated or recommended by OSHA and the National Roofing Contractors Association ("NRCA") and ensure compliance with all other federal, state and local regulations including, but not limited to, those listed in OSHA 29 CFR1962.1 150, 152,1 153 and 191-110 as they apply to heat weld application.

L. A fire watch of sufficient length must be kept during and after all heat welding is completed. Maintain a fire watch for a minimum of one hour after suspension of work activities each workday. A fire watch may need to be longer depending on the size of the roofing protect and the design or configuration of the building. Special attention should be given to potential hot spots or smoldering materials such as carts, wall flashings, and around penetrations roof top equipment and the roof perimeter. The person performing fire watch should use and infrared heat-sensing device to detect hot spots and smoldering materials; notify the local fire department authorities and COR.

M. Observe all fire prevention and safety policies and practices during the installation of the roof system. Pro vide training to their personnel for proper roofing and safety practices as well as responding to emergency situations at the job site. Always keep a first aid kit on the job site; individuals administering first aid must be properly qualified per OSHA 29 CFR1910.151(b).

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form, without monetary limitation, in which manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period. Failure includes roof leaks.

1. Special warranty includes roofing membrane, base flashings, insulation, walkways and other components of roofing system.

2. Warranty Period: 20 years from date of Substantial Completion.

B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering Work of this Section, including all components of roofing system such as roofing membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, roof pavers, and walkway products, for the following warranty period:

1. Warranty Period: **Two** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

a. Barrett Company.

b. Bitec Inc.

c. Certain Teed Corporation.

d. Danoza Caribbean Inc.

e. Ecology Roof Systems

f. Firestone Building Products Company.

g. GAF Materials Corporation.

h. Garland Co., Inc. (The)

i. Hickman, W.P. Systems, Inc.

j. Honeywell Commercial Roofing Systems

k. IKO Industries, Inc.

l. Johns Manville International, Inc.

m. Koppers Industries, Inc.

n. Malarkey MBTechnology Corporation

o. Monsey-Bakor; Div. of Henry Company.

p. Polyglass USA, Inc.

q. Siplast, Inc.

r. Soprema Roofing and Waterproofing Inc.

s. TAMKO Roofing Products, Inc.

t. Tremco, Inc.

u. U.S. Intec, Inc.

2.2 SBS-MODIFIED ASPHALT-SHEET MATERIALS (HEAT WELDED APPLICATIONS)

A. Roofing Membrane Sheet: ASTM D 6163, Grade S, Type I or II, glass-fiber-reinforced or ASTM D 6162, Grade S, Type I or II, composite polyester-and glass-fiber-reinforce**d** SBS-modified asphalt sheet; smooth surfaced; suitable for application method specified.

B. Roofing Membrane Cap Sheet: ASTM D 6163, Grade G, Type I or II, glass-fiber-reinforced or ASTM D 6162, Grade G, Type I or II, composite polyester- and glass-fiber-reinforced, SBS-modified asphalt sheet; granular surfaced; suitable for application method specified, with white granule color.

2.3 BASE FLASHING SHEET MATERIALS

A. Backer Sheet: ASTM D 4601, Type I or Type II, asphalt-impregnated and coated, glass fiber sheet, dusted with fine material surfacing on both sides.

B. Flashing Sheet: ASTM D 6163, Grade G, Type I or Type II, glass-fiber reinforced or ASTM D 6162, Grade G, Type I or II, composite polyester and glass fiber reinforced, SBS-modified asphalt sheet; white granular surfaced, suitable for application method specified, and as follows:

C. Glass Fiber Fabric: Woven glass fiber cloth treated with asphalt, complying with ASTM D 1668, Type I.

2.4 AUXILIARY ROOFING MEMBRANE MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing membrane.

B. The use of hot-applied asphalt will not be permitted.

C. Mastic Sealant: Polyisobutylene, plain or modified bitumen, non-hardening, non-migrating, non-skinning and nondrying.

D. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roofing membrane components to substrate, tested by manufacturer for required pullout strength, and acceptable to roofing system manufacturer.

E. Metal Flashing Sheet: Metal flashing sheet is specified in Division 7 Section “Sheet Metal Flashing and Trim.”

F. Miscellaneous Accessories: Provide miscellaneous accessories recommended by roofing system manufacturer.

2.5 ROOF INSULATION

A. General: Provide preformed roof insulation boards that comply with requirements and referenced standards, selected from manufacturer's standard sizes and of thicknesses indicated.

B. Insulation top or single layer: composite polyisocyanurate board insulation: ASTM C 1289, faced with insulation board on one major surface, as indicated below by type, and felt or glass-fiber mat facer on the other.

1. Type III perlite-insulation-board facer ASTM C 728 ½ inch (13 mm)

C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to provide slopes shown on the drawings.

D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated. Fabricate to slopes indicated.

2.6 INSULATION ACCESSORIES

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatible with membrane roofing.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer

C. Cold Fluid-Applied Adhesive: Manufacturer's standard cold fluid-applied adhesive formulated to adhere roof insulation to substrate.

D. Insulation Cant Strips: ASTM C 208, Type II, Grade I, cellulosic-fiber insulation board, or ASTM C728 FesCant Plus.

E. Wood Nailer Strips: Comply with requirements in Division 6 Section "Miscellaneous Carpentry."

F. Tapered Edge Strips: ASTM C 728, perlite insulation board.

G. Substrate Joint Tape: 6 or 8 inch (150 or 200 mm) wide, coated, glass-fiber joint tape.

2.7 REPAIR MATERIALS

A. Use repair materials indicated to existing materials;

1. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.

2. Use materials whose installed performance equals or surpasses that of existing materials.

B. Comply with material and installation requirements specified in individual specification sections.

PART 3 - EXECUTION

3.1 DEMOLITION

A. Refer to Division 2 Section, “Selective Demolition” for general requirements related to removal of existing roofing, flashing and sheet metal items, and associated construction.

B. Definitions:

1. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed, removed and salvaged, or removed and reinstalled.

2. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

C. Materials Ownership: Prior to assuming ownership of demolished or removed items or materials, contractor shall often them to Owner. Except for items or materials indicated or selected by the Owner to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Contractor's property and shall be removed from project site.

D. Examination:

1. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

2. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

3. When unanticipated mechanical, electrical or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to COR.

4. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

E. Utility Services:

1. Existing Utilities: Maintain existing services and protect them against damage during selective demolition operations.

2. Do not interrupt existing utilities serving occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to authorities having jurisdiction.

3. Provide at least 72 hours' notice to Owner if shutdown of service is required.

F. Preparation

1. Dangerous Materials: Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with selective demolition operations.

2. Site Access and Temporary Controls: Conduct selective demolition and debris removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

a. Do not close or obstruct streets, walks, walkways, 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 governing regulations.

b. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.

c. Protect existing site improvements, appurtenances, and landscaping to remain.

3. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

a. Provide protection to ensure safe passage of people around selective demolition and demolished material removal areas and to and from occupied portions of building.

b. Provide temporary weather protection, during interval between selective demolition of existing construction and new construction, to prevent water leakage and damage to structure and interior areas.

c. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.

4. Temporary Enclosures: Provide temporary enclosures for protection of existing building and construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

G. Pollution Controls:

1. Dust Control: Use water mist, temporary enclosures, and other suitable methods to limit spread of dust and dirt. Comply with governing environmental protection regulations. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

2. Disposal: Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

a. Remove debris from elevated portions of building by chute, hoist, or other device at will convey debris to grade level in a controlled descent.

3. Cleaning: Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations begin.

H. Selective Demolition:

1. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the work within limitations of governing regulations and as follows:

a. Proceed with selective demolition systematically. Remove only that portion of existing roofing that can be covered in one day by new roofing. Complete selective demolition operations and install new roofing in each zone before disturbing the adjacent zone.

b. Remove all existing roofing materials and related flashings, adhesives, and coatings from the existing structural decks. Use methods that will leave concrete, metal and wood roof structural decks clean and free from roofing, adhesives, bituminous materials, and other materials.

c. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, roofs, or framing.

d. Dispose of demolished items and materials promptly and off site.

e. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations begin.

2. Existing Facilities: Comply with Owner's requirements for using and protecting, stairs, walkways, loading docks, building entries, and other building facilities during selective demolition operations.

3. Removed and Salvaged Items: Comply with the following:

a. Clean salvaged items.

b. Pack or crate items after cleaning. Identify contents of containers.

c. Store items in a secure area until delivery to Owner.

d. Transport items to Owner's storage area designated by Owner.

e. Protect items from damage during transport and storage.

4. Removed and Reinstalled Items: Comply with the following:

a. Clean and repair items to functional condition adequate for intended use. Paint equipment to match new equipment.

b. Pack or create items after cleaning and repairing. Identify contents of containers.

c. Protect items from damage during transport and storage.

d. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

5. Existing items to remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Owner, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.2 PATCHING AND REPAIRS

A. General: Promptly repair damage to adjacent construction caused by selective demolition operations.

B. Patching and Repairs: Where patching or repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.

1. Completely fill holes, depressions and cracks in existing concrete decks that exceed the dimensions and conditions acceptable to the roofing manufacturer. Use patching materials recommended by the roofing manufacturer that are compatible with the roofing. Apply patching material according to manufacturer's written recommendations.

2. Remove and replace damaged roof decking, with same material as in existing decking and using same methods of application. Follow decking and roofing manufacturer's recommendations.

3. Patch other substrates as recommended by roofing manufacturer.

C. Finishes: Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.

3.3 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on site.

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.4 ROOFING MEMBRANE INSTALLATION, GENERAL

A. Requirements under this heading apply to permanent roofing systems.

B. Install roofing membrane system according to roofing system manufacturer's written instructions and applicable recommendation of ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."

C. Start installation of roofing membrane in presence of roofing system manufacturer's technical personnel.

D. Cooperate with testing and inspecting agencies engaged or required to perform services for installing roofing system.

E. Coordinate installing roofing system so insulation and other components of the roofing membrane system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.

1. Provide tie-offs at end of each day's work to cover exposed roofing membrane sheets and insulation with a course of coated felt set in roofing cement with joints and edges sealed.

2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system.

3. Proceed with installation only after satisfactory conditions have been corrected.

3.5 PREPARATION FOR PERMANENT ROOFING APPLICATION

A. The requirements under this heading apply to SBS-modified bituminous membrane permanent roofing.

B. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:

1. Verify that roof openings and penetrations are in place and set and braced,

2. Verify that cants, blocking, curbs, and nailers are securely anchored to roof deck at and terminations ant that nailers match thicknesses of insulation.

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

C. Preparation:

1. Clean substrate of dust, debris, moisture and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

2. Prevent materials from entering and clogging drains and conductors and from spilling or migrating onto surfaces of other construction.

3.6 INSULATION INSTALLATION

A. Rigid Board Installation:

1. Comply with roofing system manufacturer' written instructions for installing roof insulation.

2. Insulation Cant Strips: Install and secure performed 45-degree insulation cant strips at junctures of roofing membrane system with vertical surfaces or angle changes greater that 45 degrees.

3. Install tapered insulation under area of roofing to conform to slopes indicated.

4. Install board insulation with long joints of insulation in a continuous straight line wit end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding ¼ inch (6 mm) with insulation.

5. Cut and fit insulation within ¼ inch (6mm) of nailers, projections and penetrations.

6. Install two or more layers of board insulation under area of roofing to achieve required thickness.

a. Base insulation: The base layer where required, shall be polyisocyanurate board.

b. Where tapered insulation is required to obtain the indicated slopes, install tapered, compositer polyisocyanurate board above the base insulation. Where overall thickness pf polyisocyanurate insulation is 1-1/2 inches (38mm) or greater, install 2 or more layers. Joints of each succeeding layer shall be staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.

c. Above concrete and metal decks, mechanically attach the top insulation layer, through the insulation layers below, to the concrete or metal roof deck. Install fasteners at a rate of one (1) for each two (2) square feet of roof area.

d. Above concrete and metal decks, mechanically attach the top insulation layer, through the insulation layers below, to the concrete or metal roof deck. Install fasteners at a rate of one (1) for each two (2) square feet of roof area.

7. Construct crickets, and other areas where tapered insulation is necessary to achieve the indicated slopes, of tapered polyisocyanurate board, above the base insulation layer.

8. Trim surface of board insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.

9. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.

10. Mechanically Fastened Insulation: Install each layer of board insulation loose laid, except secure top layer boards through insulation layers below to structural deck using mechanical fasteners specifically designed and sized for fastening specified roof insulations and thicknesses to deck type.

11. Fasten insulation according to requirements in FMG's "Approval Guide" for specified Windstorm Resistance Classification.

12. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof.

3.7 SBS-MODIFED MITUMINOUS MEMBRANE PERMANENT ROOFING INSTALLATION

A. Install roofing system MBS 2-1-T-M according to specification-plate classification in NRCA's "The NRCA Roofing and Waterproofing Manual" and requirements in this Section.

B. Install modified bituminous roofing membrane sheet and cap sheet according to roofing manufacturer's written instructions, starting at low point of roofing system, Extend roofing membrane sheets over and terminate beyond cants, installing as follows:

1. Heat weld (torch) to substrate.

2. Unroll roofing membrane sheets and allow them to relax for minimum time period required by manufacturer.

C. Laps: Accurately align roofing membrane sheets, without stretching, and maintain uniform side and end laps. Stagger end laps. Completely bond and seal laps leaving no voids.

1. Repair tears and voids in laps and lapped seams not completely sealed.

2. Apply roofing granules to cover exuded bead at laps while bead is hot.

D. Install roofing membrane sheets so side and end laps shed water.

3.8. FLASHING AND STRIPPING INSTALLATION

A. Requirements under this heading are applicable to both temporary and permanent roofing.

B. Install base flashing over cant strips and other sloping and vertical surfaces, at roof edges, and at penetrations through roof, and secure to substrates according to roofing system manufacturer's written instructions as follows.

1. Baker Sheet Application: Mechanically fasten backer sheet to walls or parapets. Adhere backer sheet over roofing membrane at cants in cold-applied adhesive.

2. Flashing Sheet Application: Torch apply flashing sheet to substrate.

C. Extend base flashing up walls or parapets a minimum of 8 inches (200mm) above roofing membrane and 6 inches (150 mm) onto field of roofing membrane.

D. Mechanically fasten top of base flashing securely at 6 inches on center at terminations and perimeter of roofing.

E. Install roofing membrane cap-sheet stripping where metal flanges and edgings are set on membrane roofing according to roofing system manufacturer's written instructions.

F. Roof Drains, Pipe and other Penetrations: Set and flash roof drains, pipes and other penetrations as indicated and as recommended by roofing manufacturer. Comply with approved shop drawing details.

1. Install stripping according to roofing system manufacturer's written instructions.

3.9 FIELD QUALITY CONTROL

A. Requirements under this heading apply to both temporary and permanent roofing.

B. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform roof tests and inspections and to prepare test reports.

C. Test Cuts: Test specimen will be removed to evaluate problems observed during quality assurance inspections of roofing membrane as follows:

1. Approximate quantities of components within roofing membrane will be determined according to ASTM D 3617.

2. Test specimens will be examined for interplay voids according to ASTM D 3617 and comply with criteria established in Appendix 3 of ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing".

D. Roof Inspections: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation at beginning of the installation, at 50% complete, and on completion, and submit report to the COR.

1. Notify COSR 48 hours in advance of date and time of inspection.

E. Repair or remove and replace components of roofing system where test results or inspections indicate that they do not comply with specified requirements.

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

3.10 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning gent and procedures recommended by manufacturer or affected construction.

3.11 ROOFING INSTALLER'S WARRANTY

A. WHEREAS, <Insert name & address> herein called the "Roofing Installer", has performed roofing and associated work ("work") on the following project:

1. Owner: < Insert name of the Owner>

2. Address:

3. Building Name/Type:

4. Address:

5. Area of Work:

6. Acceptance Date:

7. Warranty Period:

8. Expiration Date:

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

C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during the Warranty Period he will, at this own cost and expense, make or cause to be

made such repairs to or replacement of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

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

1. Specifically excluded form this Warranty are damages to work and other parts of the building, and to building contents, caused by:

   a. lightning

   b. peak first wind speed exceeding <Insert wind speed> mph (m/sec);

   c. fire;

   d. Failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;

   e. faulty construction of parapet walls, copings, chimneys, skylights , vents, equipment supports, and other edge conditions and penetration of the work;

   f. vapor condensation on bottom of roofing; and

   g. activity on roofing by others, including construction contractors, maintenance personnel , other persons and animals, whether authorized or unauthorized by Owner.

2. When work has been damaged by any of foregoing causes. Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.

3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.

4. During Warranty Period, if Owner allows alternation of work by anyone other that Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other workman d positioning of anything on roof, this Warranty shall become null and void on date of said alternations, but only to the extent said alternations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alternations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alternations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.

5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on the date of said change, but only to the extent said change affects work covered by this Warranty.

6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.

7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner, or a subcontract with Owner's General Contractor.

E. IN WHITNESS THEREOF, this instrument has been duly executed this <Insert day> day of <Insert month>, <Insert year>.

1. Authorized Signature:

2. Name

3. Title

END OF SECTION 07552

SECTION 07620 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes sheet metal flashing and trim in the following categories:

1. Roof-drainage systems.
2. Exposed trim, gravel stops, and fasciae.
3. Metal flashing.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 7 Section "Joint Sealants" for elastomeric sealants.

2. Division 7 Roofing Sections for flashing and roofing accessories installed integral with roofing membrane as part of roofing-system work.

1.3 PERFORMANCE REQUIREMENTS

A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing.

B. Fabricate and install flashings at roof edges to comply with recommendations of FM Loss Prevention Data Sheet 1-49 for the following wind zone:

1. Wind Zone 1: Wind pressures of 21 to 30 psf (1.00 to 1.44 kPa).

1.4 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data including manufacturer's material and finish data, installation instructions, and general recommendations for each specified flashing material and fabricated product.

C. Shop Drawings of each item specified showing layout, profiles, methods of joining, and anchorage details.

D. Samples of sheet metal flashing, trim, and accessory items, in the specified finish. Where finish involves normal color and texture variations, include Sample sets composed of 2 or more units showing the full range of variations expected.

1. 8-inch- (200-mm-) square Samples of specified sheet materials to be exposed as finished

surfaces.

E. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

1. Engage an experienced Installer who has completed sheet metal flashing and trim work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

1.6 PROJECT CONDITIONS

A. Coordinate Work of this Section with interfacing and adjoining Work for proper sequencing of each installation. Ensure best possible weather resistance, durability of Work, and protection of materials and finishes.

PART 2 - PRODUCTS

2.1 METALS

A. Copper: ASTM B 370; temper H00, cold rolled except where temper 060 is required for forming; not less than 16 oz./sq. ft. (0.55 mm thick), unless otherwise indicated.

2.2 MISCELLANEOUS MATERIALS AND ACCESSORIES

A. Burning Rod for Lead: Same composition as lead sheet.

B. Solder: ASTM B 32, Grade Sn50, used with rosin flux.

C. Fasteners: Same metal as sheet metal flashing or other noncorrosive metal as recommended by sheet metal manufacturer. Match finish of exposed heads with material being fastened.

D. Asphalt Mastic: SSPC-Paint 12, solvent-type asphalt mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15-mil (0.4-mm) dry film thickness per coat.

E. Elastomeric Sealant: Generic type recommended by sheet metal manufacturer and fabricator of components being sealed and complying with requirements for joint sealants as specified in Division 7 Section "Joint Sealants."

F. Adhesives: Type recommended by flashing sheet metal manufacturer for waterproof and weather-resistant seaming and adhesive application of flashing sheet metal.

G. Metal Accessories: Provide sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of Work, matching or compatible with material being installed; noncorrosive; size and thickness required for performance.

H. Gutter Screen: 1/4-inch (6-mm) hardware cloth installed in sheet metal frames. Fabricate screen and frame of same basic material as gutters and downspouts.

I. Roofing Cement: ASTM D 4586, Type I, asbestos free, asphalt based.

2.3 FABRICATION, GENERAL

A. Sheet Metal Fabrication Standard: Fabricate sheet metal flashing and trim to comply with recommendations of SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of the item indicated.

B. Comply with details shown to fabricate sheet metal flashing and trim that fit substrates and result in waterproof and weather-resistant performance once installed. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

C. Form exposed sheet metal Work 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.

D. Seams: Fabricate nonmoving seams in aluminum with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

E. Expansion Provisions: Space movement joints at maximum of 10 feet (3 m) with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

F. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.

G. Separate metal from noncompatible metal or corrosive substrates by coating concealed surfaces at locations of contact with asphalt mastic or other permanent separation as recommended by manufacturer.

H. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of sheet metal exposed to public view.

I. Fabricate cleats and attachment devices from same material as sheet metal component being anchored or from compatible, noncorrosive metal recommended by sheet metal manufacturer.

1. Size: As recommended by SMACNA manual or sheet metal manufacturer for application but never less than thickness of metal being secured.

2.4 SHEET METAL FABRICATIONS

A. General: Fabricate sheet metal items in thickness or weight needed to comply with performance requirements but not less than that listed below for each application and metal.

B. Exposed Trim, Gravel Stops, and Fasciae: Fabricate from the following material:

1. Copper: 16z./sq. ft. (0.7 mm thick).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions under which sheet metal flashing and trim are to be installed and verify that Work may properly commence. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Unless otherwise indicated, install sheet metal flashing and trim to comply with performance requirements, manufacturer's installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Anchor units of Work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated. Install Work with laps, joints, and seams that will be permanently watertight and weatherproof.

B. Install exposed sheet metal Work 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. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

C. Roof-Edge Flashings: Secure metal flashings at roof edges according to FM Loss Prevention Data Sheet 1-49 for specified wind zone.

D. Expansion Provisions: Provide for thermal expansion of exposed sheet metal Work. Space movement joints at maximum of 10 feet (3 m) with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

E. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pretin edges of sheets to be soldered to a width of 1-1/2 inches (38 mm), except where pretinned surface would show in finished Work.

F. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards. Fill joint with sealant and form metal to completely conceal sealant.

   1. Use joint adhesive for nonmoving joints specified not to be soldered.

G. Seams: Fabricate nonmoving seams in aluminum with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

H. Separations: Separate metal from noncompatible metal or corrosive substrates by coating concealed surfaces, at locations of contact, with asphalt mastic or other permanent separation as

recommended by manufacturer.

I. Counterflashings: Coordinate installation of counterflashings with installation of assemblies to be protected by counterflashing. Install counterflashings in reglets or receivers. Secure in a waterproof manner by means of snap-in installation and sealant, lead wedges and sealant, interlocking folded seam, or blind rivets and sealant. Lap counterflashing joints a minimum of 2 inches (50 mm) and bed with sealant.

J. Roof-Drainage System: Install drainage items fabricated from sheet metal, with straps, adhesives, and anchors recommended by SMACNA's Manual or the item manufacturer, to drain roof in the most efficient manner. Coordinate roof-drain flashing installation with roof-drainage system installation. Coordinate flashing and sheet metal items for steep-sloped roofs with roofing installation.

3.3 CLEANING AND PROTECTION

A. Clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes.

B. Provide final protection and maintain conditions that ensure sheet metal flashing and trim Work during construction is without damage or deterioration other than natural weathering at the time of Substantial Completion.

END OF SECTION 07620

SECTION 07710 - MANUFACTURED ROOF SPECIALTIES

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 manufactured roof specialties:

1. Copings.
2. Roof edge flashings.
3. Roof edge drainage systems.
4. Flashings.
5. Scuppers.
6. Conductor heads.

B. Related Sections include the following:

1. Division 6 Section “Rough Carpentry” for wood nailers.

2. Division 7 Section “Joint Sealants” for field applied sealants.

1.3 PERFORMANCE REQUIREMENTS

A. General: Manufacture and install manufactured roof specialties to resist thermally induced movement and exposure to weather without failing, rattling, leaking, and fastener disengagement.

B. FMG Listing: Manufacture and install copings, roof edge flashings that are listed in FMG's "Approval Guide" and approved for Windstorm Classification, Class 90. Identify materials with FMG markings.

C. Manufacture and install copings and roof edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressures:

1. Wind Zone 1: For velocity pressures of 10 to 20 lbf/sq.ft (0.48 to 0.96 kPa): 40 lbf/sq. ft (1.92 kP) perimeter uplift force, 60 lbf/sq.ft (2.87 kPa) corner uplift force, and 20 lbf/sq.ft (0.96 kPa) outward force.

D. Thermal Movements: Provide manufactured roof specialties that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist

rotation and avoid shear stress as a result of thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

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

E. Water Infiltration: Provide manufactured roof specialties that do not allow water infiltration to building interior.

1.4 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: Show layouts of manufactured roof specialties, including plans and elevations. Identify factory- vs. field-assembled work. Include the following:

1. Details for fastening, joining, supporting, and anchoring manufactured roof specialties including fasteners, clips, cleats, and attachments to adjoining work.
2. Details for expansion and contraction.

C. Samples for Initial Selection: For each type of manufactured roof specialty indicated with factory-applied color finishes.

D. Fabrication Samples: For copings and roof edge drainage systems and counterflashings made from 12-inch (300-mm) lengths of full-size components including fasteners, cover joints, accessories, and attachments.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, verifying compliance of copings with performance requirements.

F. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Product Options: Information on Drawings and in Specifications establishes requirements for system's 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 modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

1.6 COORDINATION

A. Coordinate installation of manufactured roof specialties with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

1.7 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace manufactured roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
3. Basis-of-Design Product: The designs for copings are based on the products named. Subject to compliance with requirements, provide either the named products or comparable products by one of the other manufacturers specified.

2.2 EXPOSED METALS

A. Copper Sheet: ASTM B 370, Temper H00 or H01, cold rolled, mill finished.

B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy and temper recommended by manufacturer for use and finish indicated, finished as follows:

1. Surface: Smooth, flat finish.
2. High-Performance Organic Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

a. Fluoropolymer 3-Coat System: Manufacturer's standard 3-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resign by weight, with a minimum total dry film thickness of 1.5 mil (0.038 mm); complying with AAMA 2605.

2.3 CONCEALED METALS

A. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy and temper recommended by manufacturer for use and structural performance indicated, mill finished.

B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy and temper recommended by manufacturer for type of use and structural performance indicated, mill finished.

C. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.

D. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation; structural quality.

2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, separators, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to withstand design loads.

C. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.

D. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane, polysulfide, silicone polymer sealant; 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 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.

G. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

H. Polyethylene Sheet: 6-mil- (0.15-mm-) thick polyethylene sheet complying with ASTM D 4397.

I. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

1. Slip Sheet: Rosin-sized paper, minimum 3 lb/100 sq. ft. (0.16 kg/sq. m).

2.5 COPINGS

A. Copings: Manufactured coping system consisting of formed-metal coping cap in section lengths not exceeding 12 feet (3.6 m) concealed anchorage, concealed splice plates with same finish as coping caps, mitered corner units, and end cap units.

1. Basis-of-Design Product: MM Systems Snap Lock Coping System or a comparable product by one of the following:

   a. Architectural Products Co.
   b. ATAS International, Inc.
   c. Castle Metal Products.
   d. Cheney Flashing Company.
   e. Hickman, W. P. Company.
   f. Merchant & Evans, Inc.
   g. Metal-Era, Inc.
   h. Metal-Fab Manufacturing LLC.
   i. MM Systems Corporation.
   j. Perimeter Systems, a division of Southern Aluminum Finishing Co.
   k. Petersen Aluminum Corp.

2. Coping Caps: Snap-on, fabricated from the following exposed metal:

   a. Aluminum: 0.050 inch (1.2 mm) thick.

3. Coping Cap Color: Dark Bronze.

4. Corners: Continuously welded.

5. Snap-on Coping Anchor Plates: Concealed, galvanized steel sheet, 12 inches (300 mm) wide, 0.028 inch (0.7 mm) thick, with integral cleats.

2.6 ROOF EDGE FLASHINGS

A. Gravel Stops: Fascias: Manufactured one-piece, formed-metal gravel stop in section lengths not exceeding 12 feet (3.6 m), with a horizontal flange and vertical leg fascia terminating in a drip edge, continuous hold-down cleat, and concealed spliced plates of same material, finish, and shape as gravel stop. Provide mitered soldered corner units.

1. Fabricate from the following exposed metal:

   a. Copper: 16 oz./sq. ft. (0.55 mm thick) cleats 2003 (0.69 mm thick).

2.7 ROOF EDGE DRAINAGE SYSTEMS

A. Gutters and Downspouts: Manufactured formed gutter in uniform section lengths not exceeding 12 feet (3.6 m) with soldered corner units, end caps, outlet tubes, and other accessories. Elevate back edge at least 1 inch (25 mm) above front gutter rim. Furnish with flat-stock gutter straps and gutter support brackets and expansion joints and expansion-joint covers fabricated from same metal as gutters.

1. Fabricate gutter from the following exposed metal:
   a. Copper: 20 oz./sq. ft. (0.69 mm thick).

2. Gutter Style: A according to SMACNA's "Architectural Sheet Metal Manual."
3. Gutter Accessories: Continuous removable leaf screen with sheet metal frame.
4. Downspouts: Rectangular closed-face with mitered elbows, manufactured from the following exposed metal. Furnish wall brackets, from same material and finish as downspouts, with anchors.
   a. Copper: 16 oz./sq. ft. (0.55 mm thick).

B. Parapet Scuppers: Manufactured scuppers with closure flange trim to exterior, 4-inch- (100-mm-) wide wall flanges to interior, and base extending 4 inches (100 mm) beyond cant or tapered strip into field of roof.

1. Manufacture parapet scuppers from the following exposed metal:

   a. Copper: 16 oz./sq. ft. (0.55 mm thick).

C. Conductor Heads: Manufactured conductor heads with flanged back and stiffened top edge and of dimensions and shape indicated complete with outlet tubes.

1. Fabricate conductor heads from the following exposed metal:

   a. Copper: 20 oz./sq.ft. (0.69 mm thick).

2.8 FLASHINGS

A. Flashings: Manufactured units in lengths not exceeding 12 feet (3.6 m) designed for surface installation and compress against base flashings with joints lapped, from the following exposed metal in thickness indicated:

1. Copper: 16 oz./sq. ft. (0.55 mm thick).

2.9 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: 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 substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of work.

1. Examine walls, roof edges, and parapets for suitable conditions for manufactured roof specialties.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install manufactured roof specialties according to manufacturer's written instructions. Anchor manufactured roof specialties securely in place and capable of resisting forces specified in performance requirements. Use fasteners, separators, sealants, and other miscellaneous items as required to complete manufactured roof specialty systems.

1. Install manufactured roof specialties with provisions for thermal and structural movement.
2. Torch cutting of manufactured roof specialties is not permitted.

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 manufacturer.

1. Coat concealed side of uncoated aluminum, stainless-steel manufactured roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing exposed-to-view components of manufactured roof specialties directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene underlayment.
3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.

C. Install manufactured roof specialties level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil-canning, buckling, or tool marks.

D. Install manufactured roof specialties to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.

E. Expansion Provisions: Provide for thermal expansion of exposed manufactured roof specialties. Space movement joints at a maximum of 12 feet (3.6 m) with no unplanned joints within 18 inches (450 mm) of corners or intersections.

F. Fasteners: Use fasteners of type and size recommended by manufacturer but of sizes that will penetrate substrate not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws.

G. Seal joints with elastomeric, butyl sealant as required by manufacturer of roofing specialties.

3.3 COPING INSTALLATION

A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor copings to resist uplift and outward forces according to performance requirements.

1. Interlock face and back leg drip edges into continuous cleats anchored to substrate at manufacturer's recommended spacing.

3.4 ROOF EDGE FLASHING INSTALLATION

A. Install cleats, cant dams, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor roof edgings to resist uplift and outward forces according to performance requirements.

3.5 ROOF EDGE DRAINAGE SYSTEM INSTALLATION

A. General: Install gutters, downspouts, parapet scuppers and conductor heads to produce a complete roof drainage system according to manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof drainage system.

B. Gutters: Join and seal gutter lengths. Attach gutters to firmly anchored straps spaced not more than 36 inches (900 mm) apart. Slope gutters to downspouts.

1. Install gutter with expansion joints at locations indicated but not exceeding 50 feet (15.2 m) apart. Install expansion joint caps.
2. Install continuous gutter screens on gutters with noncorrosive fasteners, removable for cleaning gutters.

C. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inches (1500 mm) o.c. in between.

1. Provide elbows at base of downspout to direct water away from building.

2. Connect downspouts to underground drainage system indicated.

D. 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.

1. Anchor scupper closure trim flange to exterior wall and seal or solder to scupper.
2. Loosely lock front edge of scupper with conductor head.

3.6 FLASHING INSTALLATION

A. Flashings: Coordinate installation of flashings with installation of base flashings. Insert flashings and fit tightly to base flashings. Extend flashings 4 inches (100 mm) over base flashings. Lap flashing joints a minimum of 4 inches (100 mm) and bed with elastomeric sealant.

3.7 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as manufactured roof specialties are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.

D. Replace manufactured roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 07710

SECTION 07901 - JOINT SEALANTS

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 this Section.

1.2 SUMMARY

A. This Section includes joint sealants for the following locations:

1. Exterior joints in vertical surfaces and nontraffic horizontal surfaces as indicated below:

   a. Perimeter joints between frames of doors, windows and louvers, brickwork and concrete.

2. Interior joints in vertical surfaces and horizontal nontraffic surfaces as indicated below:

   a. Perimeter joints of exterior openings where indicated.

   b. Perimeter joints between interior wall surfaces and frames of interior doors and windows.

   c. Perimeter joints of toilet fixtures.

   d. Other joints as indicated.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that have been produced and installed to establish and to maintain watertight and airtight continuous seals without causing staining or deterioration of joint substrates.

B. Provide joint sealants for interior applications that have been produced and installed to establish and maintain airtight continuous seals that are water resistant and cause no staining or deterioration of joint substrates.

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data from manufacturers for each joint sealant product required.

1. Certification by joint sealant manufacturer that sealants plus the primers and cleaners required for sealant installation comply with local regulations controlling use of volatile organic compounds.

C. Samples for initial selection purposes in form of manufacturer's standard bead samples, consisting of strips of actual products showing full range of colors available, for each product exposed to view.

D. Certificates from manufacturers of joint sealants attesting that their products comply with specification requirements and are suitable for the use indicated.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed joint sealant applications similar in material, design, and extent to that indicated for Project that have resulted in construction with a record of successful in-service performance.

B. Single Source Responsibility for Joint Sealant Materials: Obtain joint sealant materials from a single manufacturer for each different product required.

1. Testing will not be required when Joint sealant manufacturer shall submit joint preparation data that are acceptable to Contracting Officer and are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

C. Pre-Installation Conference: Conduct conference at Project site to comply with requirements of the Division 1 Section covering this activity.

1.6 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 period for use, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Conditions: Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside the limits permitted by joint sealant manufacturer.

2. When ambient and substrate temperature conditions are outside the limits permitted by joint sealant manufacturer or below 40 deg. F.

3. When joint substrates are wet.

B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than 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, joint fillers, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

B. Colors: Provide color of exposed joint sealants to comply with the following:

1. Provide selections made by the COTR from manufacturer's full range of standard colors for products of type indicated.

2.2 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing elastomeric sealants that comply with ASTM C 920 and other requirements indicated on each Elastomeric Joint Sealant Data Sheet at end of this Section, including those requirements referencing ASTM C 920 classifications for Type, Grade, Class, and Uses.

B. Available Products: Subject to compliance with requirements, elastomeric sealants that may be incorporated in the Work include, but are not limited to, the products specified in each Elastomeric Sealant Data Sheet.

2.3 JOINT SEALANT BACKING

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

B. Plastic Foam Joint Fillers: Preformed, compressible, resilient, nonstaining, nonwaxing, nonextruding strips of flexible plastic foam of material indicated below and of size, shape, and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

1. Closed-cell polyethylene foam, nonabsorbent to liquid water and gas, nonoutgassing in unruptured state.

2.4 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 in any way joint substrates and adjacent nonporous surfaces, and formulated to promote optimum adhesion of sealants with 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. Do not proceed with installation of joint sealants until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with recommendations of joint sealant manufacturer 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 concrete, masonry, and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air.

3. Remove laitance and form release agents from concrete.

B. Joint Priming: Prime joint substrates where indicated or where recommended by joint sealant manufacturer based on preconstruction joint sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's recommendations. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint sealant manufacturer's printed installation instructions applicable to products and applications indicated, except where 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. Installation of Sealant Backings: Install sealant backings to comply with the following requirements:

1. Install joint fillers of type indicated to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

a. Do not leave gaps between ends of joint fillers.

b. Do not stretch, twist, puncture, or tear joint fillers.

D. Installation of Sealants: Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at the same time sealant backings are installed.

E. Tooling of Nonsag Sealants: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated, to eliminate air pockets, and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

1. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

2. Provide flush joint configuration, per Figure 5B in ASTM C 1193, where indicated.

a. Use masking tape to protect adjacent surfaces of recessed tooled joints.

3.4 CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints as 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 or from damage resulting from construction operations or other causes so that they 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 that and installations with repaired areas are indistinguishable from original work.

ELASTOMERIC JOINT SEALANT DATA SHEET

Elastomeric Joint Sealant Designation: ES #1

Base Polymer: Neutral-curing silicone

Type: S (single component)

Grade: NS (nonsag)

Class: 25

Use Related to Exposure: NT (nontraffic)

Uses Related to Joint Substrates: M, O

Available Products: Dow Corning, type 795; GE, type Silglaze N; Pecora, type 895; Tremco, type Spectrem 2.

END OF SECTION 07901

SECTION 08110 - STEEL 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes steel doors and frames.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 4 Section "Unit Masonry" for building anchors into and grouting frames in masonry construction.

2. Division 8 Section "Door Hardware" for door hardware and weatherstripping.

3. Division 8 Section "Glazing" for glass in steel doors and sidelights.

4. Division 9 Section "Gypsum Board Assemblies" for spot grouting frames and anchors in gypsum board partitions.

5. Division 9 Section "Painting" for field painting primed doors and frames.

1.3 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data for each type of door and frame specified, including details of construction, materials, dimensions, hardware preparation, core, label compliance, sound ratings, profiles, and finishes.

C. Shop Drawings showing fabrication and installation of steel doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of door and frame hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.

D. Door Schedule: Submit schedule of doors and frames using same reference numbers for details and openings as those on Contract Drawings.

1. Indicate coordination of glazing frames and stops with glass and glazing requirements.

1.4 QUALITY ASSURANCE

A. Provide doors and frames complying with ANSI/SDI 100 "Recommended Specifications for Standard Steel Doors and Frames" and as specified.

B. Fire-Rated Door Assemblies: Units that comply with NFPA 80, are identical to door and frame assemblies tested for fire-test-response characteristics per ASTM E 152, and are labeled and listed by UL, Warnock Hersey, or another testing and inspecting agency acceptable to authorities having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames cardboard-wrapped or crated to provide protection during transit and job storage. Provide additional protection to prevent damage to finish of factory-finished doors and frames.

B. Inspect doors and frames on delivery for damage. Minor damages may be repaired provided refinished items match new work and are acceptable to Architect; otherwise, remove and replace damaged items as directed.

C. Store doors and frames at building site under cover. Place units on minimum 4-inch- (100-mm-) high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber. If cardboard wrappers on doors become wet, remove cartons immediately. Provide minimum 1/4-inch (6-mm) spaces between stacked doors to promote air circulation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Hot-Rolled Steel Sheets and Strip: Commercial-quality carbon steel, pickled and oiled, complying with ASTM A 569 (ASTM A 569M).

B. Cold-Rolled Steel Sheets: Carbon steel complying with ASTM A 366 (ASTM A 366M), commercial quality, or ASTM A 620 (ASTM A 620M), drawing quality, special killed.

C. Supports and Anchors: Fabricated from not less than 0.0478-inch- (1.2-mm-) thick steel sheet; 0.0516-inch- (1.3-mm-) thick galvanized steel where used with galvanized steel frames.

D. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where items are to be built into exterior walls, hot-dip galvanize complying with ASTM A 153, Class C or D as applicable.

2.2 DOORS

A. Steel Doors: Provide 1-3/4-inch- (44-mm-) thick doors of materials and ANSI/SDI 100 grades and models specified below, or as indicated on Drawings or schedules:

1. Interior Doors: Grade III, extra heavy-duty, Model 2, seamless design, minimum 0.0598-inch- (1.5-mm-) thick cold-rolled steel sheet faces.

2.3 FRAMES

A. Provide metal frames for doors, transoms, sidelights, borrowed lights, and other openings, according to ANSI/SDI 100, and of types and styles as shown on Drawings and schedules. Conceal fastenings, unless otherwise indicated. Fabricate frames of minimum 0.0598-inch- (1.5-mm-) thick cold-rolled steel sheet.

1. Fabricate frames with mitered or coped and continuously welded corners.

B. Door Silencers: Except on weatherstripped frames, drill stops to receive 3 silencers on strike jambs of single-door frames and 2 silencers on heads of double-door frames.

C. Plaster Guards: Provide minimum 0.0179-inch- (0.45-mm-) thick steel plaster guards or mortar boxes at back of hardware cutouts where mortar or other materials might obstruct hardware operation and to close off interior of openings.

D. Grout: When required in masonry construction, as specified in Division 4 Section "Unit Masonry."

2.4 FABRICATION

A. Fabricate steel door and frame units to be rigid, neat in appearance, and free from defects, warp, or buckle. Where practical, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory assembled before shipment, to assure proper assembly at Project site. Comply with ANSI/SDI 100 requirements.

1. Internal Construction: The following core material according to SDI standards:

a. Rigid mineral fiber with internal sound deadener on inside of face sheets.

2. Clearances: Not more than 1/8 inch (3.2 mm) at jambs and heads, except not more than 1/4 inch (6.4 mm) between non-fire-rated pairs of doors. Not more than 3/4 inch (19 mm) at bottom.

a. Fire Doors: Provide clearances according to NFPA 80.

B. Fabricate exposed faces of doors and panels, including stiles and rails of nonflush units, from only cold-rolled steel sheet.

C. Tolerances: Comply with SDI 117 "Manufacturing Tolerances Standard Steel Doors and Frames."

D. Fabricate concealed stiffeners, reinforcement, edge channels, louvers, and moldings from either cold- or hot-rolled steel sheet.

E. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.

F. Hardware Preparation: Prepare doors and frames to receive mortised and concealed hardware according to final door hardware schedule and templates provided by hardware supplier. Comply with applicable requirements of SDI 107 and ANSI A115 Series specifications for door and frame preparation for hardware.

G. Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for surface-applied hardware may be done at Project site.

H. Locate hardware as indicated on Shop Drawings or, if not indicated, according to the Door and Hardware Institute's (DHI) "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."

I. Glazing Stops: Minimum 0.0359-inch- (0.9-mm-) thick steel or 0.040-inch- (1-mm-) thick aluminum.

1. Provide screw-applied, removable, glazing beads on inside of glass in doors.

2.5 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual" for recommendations relative to applying and designating finishes.

B. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for steel sheet finishes.

C. Apply primers and organic finishes to doors and frames after fabrication.

2.6 STEEL SHEET FINISHES

A. Surface Preparation: Solvent-clean surfaces to comply with SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel to comply with SSPC-SP 5 (White Metal Blast Cleaning) or SSPC-SP 8 (Pickling).

B. Pretreatment: Immediately after surface preparation, apply a conversion coating of type suited to organic coating applied over it.

C. Factory Priming for Field-Painted Finish: Apply shop primer that complies with ANSI A224.1 acceptance criteria, is compatible with finish paint systems indicated, and has capability to provide a sound foundation for field-applied topcoats. Apply primer immediately after surface preparation and pretreatment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install steel doors, frames, and accessories according to Shop Drawings, manufacturer's data, and as specified.

B. Placing Frames: Comply with provisions of SDI 105, unless otherwise indicated. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.

1. Except for frames located in existing concrete, masonry, or gypsum board assembly construction, place frames before constructing enclosing walls and ceilings.

2. In masonry construction, install at least 3 wall anchors per jamb adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Acceptable anchors include masonry wire anchors and masonry T-shaped anchors.

3. At existing concrete or masonry construction, install at least 3 completed opening anchors per jamb adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Set frames and secure to adjacent construction with bolts and masonry anchorage devices.

4. In metal-stud partitions, install at least 3 wall anchors per jamb at hinge and strike levels. In steel-stud partitions, attach wall anchors to studs with screws.

5. Install fire-rated frames according to NFPA 80.

C. Door Installation: Fit hollow-metal doors accurately in frames, within clearances specified in ANSI/SDI 100.

1. Fire-Rated Doors: Install with clearances specified in NFPA 80.

3.2 ADJUSTING AND CLEANING

A. Prime Coat Touchup: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.

B. Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames.

END OF SECTION 08110

SECTION 08311 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawing 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. Wall access doors and frames.

B. Related Sections include the following:

1. Division 9 Section "Gypsum Board Assemblies" for walls.

1.3 SUBMITTALS

A. Product Data: For each type of door and frame indicated. Include construction details relative to materials, individual components and profiles, finishes, and fire ratings (if required) for access doors and frames.

B. Shop Drawings: Show fabrication and installation details of customized doors and frames. Include plans, elevations, sections, details, and attachments to other Work.

1. Method of attaching door frames to surrounding construction.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain doors and frames 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 equipment, and indicate on schedule specified in "Submittals" Article.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Hot-Rolled Steel Sheets: ASTM A 569/A 569M, Commercial Steel (CS), Type B; free of scale, pitting, and surface defects; pickled and oiled; with minimum thickness indicated representing specified nominal thickness according to ASTM A 568/A 568M.

B. Cold-Rolled Steel Sheets: ASTM A 366/A 366M, Commercial Steel (CS), or ASTM A 620/A 620M, Drawing Steel (DS), Type B; stretcher-leveled standard of flatness; with minimum thickness indicated representing specified nominal thickness according to ASTM A 568/A 568M. Electrolytic zinc-coated steel sheet, complying with ASTM A 591/A 591M, Class C coating, may be substituted at fabricator's option.

C. 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 [gypsum board] [gypsum base for veneer plaster] [gypsum board and gypsum base for veneer plaster].

2.2 PAINT

A. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664; selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.

2.3 ACCESS DOORS AND FRAMES

A. Flush Access Doors and Frames with Exposed Trim: Fabricated from steel sheet.

1. Locations: Gypsum board surfaces.
2. Door: Minimum 0.060-inch- (1.5-mm-) thick sheet metal, set flush with exposed face flange of frame.
3. Frame: Minimum 0.060-inch- (1.5-mm) thick sheet metal with drywall bead.
4. Hinges: Continuous piano hinge.
5. Latch: Screwdriver operated cam latch.
6. Lock: Key-operated cylinder lock.

2.4 FABRICATION

A. General: Provide access door 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. Steel 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. Exposed Flanges: Nominal 1 inch (25 mm) wide around perimeter of frame.
2. For trimless frames with drywall bead for installation in gypsum board assembly, provide edge trim for gypsum board securely attached to perimeter of frames.
3. Provide mounting holes in frames to attach frames to metal framing in drywall construction.

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.

2.5 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.

2.6 STEEL FINISHES

A. Surface Preparation: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed metal fabrications:

1. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."

B. Apply shop primer to uncoated surfaces of metal fabrications. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting.

PART 3 - EXECUTION

3.1 PREPARATION

A. Advise installers of other work about specific requirements relating to access door and floor door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts, and anchoring devices.

3.2 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 access doors with trimless frames flush with adjacent finish surfaces.

3.3 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 08311

SECTION 08410 - ALUMINUM ENTRANCES

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. Exterior aluminum entrance doors.

B. Related sections include the following:

1. Division 7 Section "Joint Sealants" for joint sealants installed as part of aluminum entrance and storefront systems.

2. Division 8 Section "Glazing."

1.3 SYSTEM DESCRIPTION

A. General: Provide aluminum entrance capable of withstanding loads and thermal and structural movement requirements indicated without failure, based on testing manufacturer's standard units in assemblies similar to those indicated for this Project. Failure includes the following:

1. Air infiltration and water penetration exceeding specified limits.

2. Framing members transferring stresses, including those caused by thermal and structural movement, to glazing units.

B. Glazing: Physically and thermally isolate glazing from framing members.

C. Thermally Broken Construction: Provide systems that isolate aluminum exposed to exterior from aluminum exposed to interior with a material of low thermal conductance.

D. Unit types: Those severally produced for commercial application.

E. Air Infiltration: Provide entrance and storefront systems with permanent resistance to air leakage through fixed glazing and frame areas of not more than 0.06 cfm/sq. ft. (0.3 L/s/sq. m) of fixed wall area when tested according to ASTM E 283 at a static-air-pressure difference of 1.57 lbf/sq. ft. (75.2 Pa).

F. Water Penetration: Provide entrance and storefront systems that do not evidence water leakage through fixed glazing and frame areas when tested according to ASTM E 331 at minimum differential pressure of 20 percent of inward-acting wind-load design pressure as defined by ASCE 7, "Minimum Design Loads for Buildings and Other Structures," but not less than 6.24 lbf/sq. ft. (299 Pa). Water leakage is defined as follows:

1. Uncontrolled water infiltrating systems or appearing on systems' normally exposed interior surfaces from sources other than condensation. Water controlled by flashing and gutters that is drained back to the exterior and cannot damage adjacent materials or finishes is not water leakage.

G. Condensation Resistance: Provide storefront systems with condensation resistance factor (CRF) of not less than 45 when tested according to AAMA 1503.1.

H. Dimensional Tolerances: Provide entrance and storefront systems that accommodate dimensional tolerances of building frame and other adjacent construction.

1.4 SUBMITTALS

A. Product Data: For each product specified. Include details of construction relative to materials, dimensions of individual components, profiles, and finishes.

B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components, provisions for expansion and contraction, and attachments to other work.

C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for units with factory-applied color finishes.

D. Cutaway Sample: Of each vertical-to-horizontal framing intersection of systems, made from minimum 6-inch (150-mm) lengths of full-size components and showing details of the following:

1. Joinery.

E. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.

F. Sealant Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating that materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with sealants; include joint sealant manufacturers' written interpretation of test results relative to sealant performance and recommendations for primers and substrate preparation needed to obtain adhesion.

G. Field Test Reports: Indicate and interpret test results for compliance with storefront systems' performance requirements.

H. Product Test Reports: Based on evaluation of tests performed by manufacturer and witnessed by a qualified independent testing agency, indicate compliance of entrance and storefront systems with requirements based on comprehensive testing of current systems.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer to assume engineering responsibility and perform work of this Section who has specialized in installing entrance and storefront systems similar to those required for this Project and who is acceptable to manufacturer.

1. Engineering Responsibility: Prepare data storefront systems, including Shop Drawings,

based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Testing Agency Qualifications: Demonstrate to C.O.R. satisfaction, based on C.O.R. evaluation of criteria conforming to ASTM E 699, that the independent testing agency has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.

C. Source Limitations: Obtain storefront system through one source from a single manufacturer.

D. Product Options: Drawings indicate size, profiles, and dimensional requirements and storefront systems and are based on the existing system.

1. Do not modify intended aesthetic effect, as judged solely by C.O.R., except with C.O.R. approval and only to the extent needed to comply with performance requirements. Where modifications are proposed, submit comprehensive explanatory data to Architect for review.

E. Preconstruction Sealant Testing: Perform sealant manufacturers' standard tests for compatibility and adhesion of sealants with each material that will come in contact with sealants and each condition required by system.

1. Test a minimum of 8 samples of each metal, glazing, and other material.

2. Prepare samples using techniques and primers required for installed systems.

3. Perform tests under environmental conditions that duplicate those under which systems will be installed.

4. For materials that fail tests, determine corrective measures required to prepare each material to ensure compatibility with and adhesion of sealants, including, but not limited to, specially formulated primers. After performing these corrective measures on the minimum number of samples required for each material, retest materials.

F. Welding Standards: Comply with applicable provisions of AWS D1.2, "Structural Welding Code--Aluminum."

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating systems without field measurements. Coordinate construction to ensure actual dimensions correspond to established dimensions.

1.7 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the government of other rights the government may have under other provisions of the Contract

Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Warranty: Submit a written warranty executed by the manufacturer agreeing to repair or replace components of entrance and storefront systems that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to, the following:

1. Structural failures including, but not limited to, excessive deflection.

2. Failure of system to meet performance requirements.

3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

4. Failure of operating components to function normally.

5. Water leakage through fixed glazing and frame areas.

C. Warranty Period: 2 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated, complying with the requirements of standards indicated below.

1. Sheet and Plate: ASTM B 209 (ASTM B 209M).

2. Extruded Bars, Rods, Shapes, and Tubes: ASTM B 221 (ASTM B 221M).

3. Extruded Structural Pipe and Tubes: ASTM B 429.

4. Bars, Rods, and Wire: ASTM B 211 (ASTM B 211M).

5. Welding Rods and Bare Electrodes: AWS A5.10.

B. Glazing as specified in Division 8 Section "Glazing."

C. Glazing Gaskets: Manufacturer's standard pressure-glazing system of black, resilient glazing gaskets, setting blocks, and shims or spacers, fabricated from an elastomer of type and in hardness recommended by system and gasket manufacturer to comply with system performance requirements. Provide gasket assemblies that have corners sealed with sealant recommended by gasket manufacturer.

D. Spacers, Setting Blocks, Gaskets, and Bond Breakers: Manufacturer's standard permanent, nonmigrating types in hardness recommended by manufacturer, compatible with sealants, and suitable for system performance requirements.

E. Framing system gaskets, sealants, and joint fillers as recommended by manufacturer for joint type.

F. Sealants and joint fillers for joints at perimeter of entrance and storefront systems as specified in Division 7 Section "Joint Sealants."

G. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements, except containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

2.2 COMPONENTS

A. Glazing Stops and Gaskets: Provide manufacturer's standard snap-on extruded-aluminum glazing stops and preformed gaskets.

B. Closures: Provide all angle and bent plate closures.

C. Brackets and Reinforcements: Provide manufacturer's standard brackets and reinforcements that are compatible with adjacent materials. Provide nonstaining, nonferrous shims for aligning system components.

D. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Reinforce members as required to retain fastener threads.

2. Do not use exposed fasteners, except for hardware application. For hardware application, use countersunk Phillips flat-head machine screws finished to match framing members or hardware being fastened, unless otherwise indicated.

E. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123 or ASTM A 153 requirements.

F. Concealed Flashing: Dead-soft, 0.018-inch- (0.457-mm-) thick stainless steel, complying with ASTM A 666, of type selected by manufacturer for compatibility with system.

G. FINISH HARDWARE

1. Overhead Surface-Mounted Door Closers (1 required).

Surface-mounted door closers shall be LCN 4041 PA only, finish BHMA 689. Paint color to match doors.

Closer arms and mounting brackets shall be provided as required. Drop plates shall be provided, sized for the door stile dimension.

2. Butt Hinges (1-1/2 pairs per leaf)

   Hinges shall be full-mortise, template, extra-heavy, ball bearing, five-knuckle type with button tips, conforming to BHMA A156.1, Type A5111, size 130 by 100 millimeter, BHMA 613. Hinges for exterior out-swinging doors shall have pins that cannot be removed when the door is in the closed position. Hinges shall be the product of one manufacturer.

3. Lock Mortise (1 required)

   Shall be the product of Lockwood Architectural Hardware Series 7100 only, finish BHMA 613, lever handle.

4. Pull Bar (2 required)

   Shall be extruded aluminum, BHMA A156.6, Type J501.

5. Push Bar (2 required)

   Shall be extruded aluminum, BHMA A156.6, Type J502.

6. Thresholds (1 required)

   Thresholds shall be manufacturer’s standard extruded aluminum with grooved tread, providing ADA clearances.

2.3 FABRICATION

A. General: Fabricate components that, when assembled, will have accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

   1. Fabricate components for screw-spline frame construction.

B. Forming: Form shapes with sharp profiles, straight and free of defects or deformations, before finishing.

C. Prepare components to receive concealed fasteners and anchor and connection devices.

D. Fabricate components to drain water passing joints and condensation and moisture occurring or migrating within the system to the exterior.

E. Welding: Weld components to comply with referenced AWS standard. Weld before finishing components to greatest extent possible. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

F. Glazing Channels: Provide minimum clearances for thickness and type of glass indicated according to FGMA's "Glazing Manual."

G. Glazing Channels: Provide minimum clearances for thickness and type of plastic sheet indicated according to plastic sheet manufacturer's written instructions.

H. Metal Protection: Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

2.4 ALUMINUM FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal

Products" for recommendations relative to applying and designating finishes.

B. 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.

C. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.

D. Class I, Color Anodic Finish: AA-M12C22A42/A44 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 606.1 or AAMA 608.1.

1. Color: Dark bronze, match exiting.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of entrance and storefront systems. Do not proceed with installation until unsatisfactory conditions have been corrected. Field measure all conditions.

3.2 INSTALLATION

A. General: Comply with manufacturer's written instructions for protecting, handling, and installing entrance and storefront systems. Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight.

B. Metal Protection: Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose. 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 and condensation and moisture occurring or migrating within the system to the exterior.

D. Set continuous sill members and flashing in a full sealant bed to provide weathertight construction, unless otherwise indicated. Comply with requirements of Division 7 Section "Joint Sealants."

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

F. Install all closure angles and plate bedded in sealant.

G. Install glazing to comply with requirements of Division 8 Section "Glazing," unless otherwise indicated.

1. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

H. Install perimeter sealant to comply with requirements of Division 7 Section "Joint Sealants," unless otherwise indicated.

I. Erection Tolerances: Install entrance and storefront systems to comply with the following maximum tolerances:

1. Variation from Plane: Limit variation from plane or location shown to 1/8 inch in 12 feet (3 mm in 3.7 m); 1/4 inch (6 mm) over total length.

2. Alignment: Where surfaces abut in line, limit offset from true alignment to 1/16 inch (1.5 mm). Where surfaces meet at corners, limit offset from true alignment to 1/32 inch (0.8 mm).

3. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch (3 mm).

3.3 FIELD QUALITY CONTROL

A. Repair or remove and replace Work that does not meet requirements or that is damaged by testing; replace to conform to specified requirements.

3.4 ADJUSTING AND CLEANING

A. Remove excess sealant and glazing compounds, and dirt from surfaces.

3.5 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure entrance and storefront systems are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 08410

SECTION 08712 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Commercial door hardware for the following:

a. Swinging doors.

B. Related Sections include the following:

1. Division 8 Section "Steel Doors and Frames" for astragals provided as part of a fire-rated labeled assembly and for door silencers provided as part of the frame.

1.3 SUBMITTALS

A. Product Data: Include installation details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening.

a. Organize door hardware sets in same order as in the Door Hardware Schedule at the end of Part 3.

3. Content: Include the following information:

a. Type, style, function, size, label, hand, and finish of each door hardware item.

b. Manufacturer of each item.

c. Fastenings and other pertinent information.

d. Location of each door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.

e. Explanation of abbreviations, symbols, and codes contained in schedule.

f. Mounting locations for door hardware.

g. Door and frame sizes and materials.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Keying Schedule: Prepared by or under the supervision of supplier, detailing governments final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.

D. Product Certificates:

1. Certify that door hardware approved for use on types and sizes of labeled fire doors complies with listed fire door assemblies.

E. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

1. Include lists of completed projects with project names and addresses of architects and owners, and other information specified.

F. Maintenance Data: For each type of door hardware to include in maintenance manuals specified in Division 1.

G. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Supplier Qualifications: Door hardware supplier with warehousing facilities in Project's vicinity and who is or employs a qualified Architectural Hardware Consultant, available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.

C. Architectural Hardware Consultant Qualifications: A person who is currently certified by the Door and Hardware Institute as an Architectural Hardware Consultant and 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.

D. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.

E. Regulatory Requirements: Comply with provisions of the following:

1. Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities ADAAG," ANSI A117.1, FED-STD-795, "Uniform Federal Accessibility Standards," as follows:

    a. Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist, i.e. Yale lever trim design “Pacific Beach”.

    b. Door Closers: Comply with the following maximum opening-force requirements indicated:

        1. Interior Hinged Doors: 5-lb. (22.2 N) applied perpendicular to door.

        2. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

    c. Thresholds: Not more than 1/2 inch (13 mm) high Bevel raised thresholds with a slope of not more than 1:2.

2. NFPA 101: Comply with the following for means of egress doors:

    a. Latches, Locks, and Exit Devices: Not more than 15-lb. (67 N) to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.

    b. Door Closers: Not more than 30 lb. (133 N) to set door in motion and not more than 15 lb. (67 N) to open door to minimum required width.

F. Fire-Rated Door Assemblies: Provide door hardware for assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.

1. Test Pressure: Test at atmospheric pressure.

G. Keying Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings." 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. Address for delivery of keys.

H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

I. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings." Review methods and procedures related to electrified door hardware including, but not limited to, the following:

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

2. Review required testing, inspecting, and certifying procedures.

1.2 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 related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver keys to manufacturer of key control system.

D. Deliver keys to government by registered mail or overnight package service.

1.3 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

1.4 WARRANTY

A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.

2. Faulty operation of operators and door hardware.

3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

C. Warranty Period: Three years from date of Substantial Completion, unless otherwise indicated.

D. Warranty Period for Manual Closers: 10 years from date of Substantial Completion.

1.5 MAINTENANCE SERVICE

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

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in this Section door hardware sets indicated in door and frame schedule and the Door Hardware Schedule at the end of Part 3

1. Door Hardware Sets: Requirements for quantity, item, design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Schedule at the end of Part 3. Products are identified by descriptive titles corresponding to requirements specified in Part 2.

2.2 HINGES AND PIVOTS, GENERAL

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Standards: Comply with the following:

1. Butts and Hinges: BHMA A156.1.

2. Template Hinge Dimensions: BHMA A156.7.

C. Quantity: Provide the following, unless otherwise indicated:

1. Three Hinges: For doors with heights 61 to 90 inches (1549 to 2286 mm).

D. Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

		Metal Thickness (inches)	
Maximum Door Size (inches)	Hinge Height (inches)	Standard Weight	Heavy Weight
36 by 84 by 1-3/4	4-1/2	0.134	
	4-1/2	0.134	
48 by 84 by 1-3/4	5	0.146	

		Metal Thickness (mm)	
Maximum Door Size (mm)	Hinge Height (mm)	Standard Weight	Heavy Weight
914 by 2286 by 38	114	3.4	4.6
219 by 2286 by 38	127	3.4	4.6

E. Template Requirements provide only template-produced units.

F. Hinge Base Metal: Unless otherwise indicated, provide the following:

1. Interior Hinges: Stainless steel, with stainless-steel pin.

2. Hinges for Fire-Rated Assemblies: Stainless steel, with stainless-steel pin.

G. Hinge Options: Comply with the following where indicated in the Door Hardware Schedule or on Drawings:

1. Nonremovable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the following applications:

a. Doors to receive security locks provided by the government.

2. Raised Barrel: Offset both leaves to raise barrel off door jamb.

3. Corners: Square.

H. Fasteners: Comply with the following:

1. Screws: Phillips flat-head machine screws drilled and tapped holes Finish screw heads to match surface of hinges.

2.3 HINGES

A. Antifriction-Bearing, Full-Mortise (Butt) Hinges: Standard weight; BHMA Grade 2, with 2 ball bearings; button tips; nonrising removable pins; reversible; with 3/32-inch (2.4-mm) swaging;

2.4 LOCKS AND LATCHES, GENERAL

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

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

1. Mechanical Locks and Latches:

a. Best Lock Corporation.

C. Standards: Comply with the following:

1. Bored Locks and Latches: BHMA A156.2.

D. Bored Locks: BHMA Grade 1, Series 4000.

E. Lock Trim: Comply with the following:

1. Lever: Cast

2. Escutcheon (Rose): Wrought, forged, or cast.

3. Dummy Trim: Match lever lock trim and escutcheons.

F. Lock Functions: Function numbers and descriptions indicated in the Door Hardware Schedule comply with the following:

1. Bored Locks: BHMA A156.2.

G. Backset: 2-3/4 inches (70 mm), unless otherwise indicated.

2.5 MECHANICAL LOCKS AND LATCHES

A. Bored Auxiliary Locks: Comply with the following:

1. Material: Stainless steel.

2. Deadlatches: Deadlocking latchbolt operated by key outside and turn inside Deadlocks: Deadbolt operated by key either side key outside and turn inside.

B. Flush Bolts: BHMA Grade 1 designed for mortising into door edge.

2.6 DOOR BOLTS

A. Half-Round Surface Bolts: 6-inch (152-mm) polished brass or burnished steel half-round rod and knob; minimum 7/8-inch (22-mm) throws; with universal strike.

B. Interlocking Surface Bolts: 6-inch (152-mm) extruded brass or aluminum, interlocking track and rod; minimum 15/16-inch (24-mm) throws; with universal or mortise strike.

C. Manual-Extension Flush Bolts: Fabricated from extruded brass or aluminum, with 12-inch (305-mm) rod actuated by flat lever**;** listed and labeled for fire-rated doors. Provide matching strike.

2.7 EXIT DEVICES, GENERAL

A. Standard: BHMA A156.3.

1. BHMA Grade: Grade 1.

B. Certified Products: Provide exit devices listed in BHMA's "Directory of Certified Exit Devices."

C. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.

2.8 EXIT DEVICES

A. Rim Exit Devices: Comply with the following:

1. Type: Type 4, narrow stile

2. Actuating Bar: Push pad

3. Material: Stainless steel

B. Electrified Exit Device Options: Provided by government interconnected with exit device on push side of door.

2.9 CYLINDERS AND KEYING

A. Manufacturers: Subject to compliance with requirements, provided by the Government.

2.10 STRIKES

A. Standards: Comply with the following:

1. Strikes for Bored Locks and Latches: BHMA A156.2.

2. Strikes for Mortise Locks and Latches: BHMA A156.13.

3. Strikes for Interconnected Locks and Latches: BHMA A156.12.

4. Strikes for Auxiliary Deadlocks: BHMA A156.5.

5. Dustproof Strikes: BHMA A156.16.

6. Electric Strikes: BHMA A156.5.

B. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.

C. Dustproof Strikes: BHMA Grade 1, complying with the following:

1. Jamb Type: Polished wrought brass, with 3/4-inch- (19-mm-) diameter, spring-tension plunger.

2.11 OPERATING TRIM, GENERAL

A. Standard: Comply with BHMA A156.6.

B. Materials: Fabricate from stainless steel unless otherwise indicated.

2.12 OPERATING TRIM

A. Flat Push Plates: 0.050 inch (1.3 mm) thick, 4 inches wide by 16 inches high (102 mm wide by 406 mm high); with square corners and beveled edges, secured with exposed screws.

B. Pull-Plate Door Pulls: 0.050-inch- (1.3-mm-) thick plate, 4 inches wide by 16 inches high (102 mm wide by 406 mm high), with square corners and beveled edges; 3/4-inch (19-mm) constant-diameter pull, with minimum clearance of 1-1/2 inches (38 mm) from face of door; fastened at 8 inches (203 mm) o.c.

1. Mounting: Back to back with threaded sleeves.

2.13 CLOSERS, GENERAL

A. Standards: Comply with the following:

1. Closers: BHMA A156.4.

B. Surface Closers: BHMA Grade 2.

C. Certified Products: Provide door closers listed in BHMA's "Directory of Certified Door Closers."

D. Hold-Open Closers/Detectors: Coordinate and interface integral smoke detector and closer device with fire alarm system.

E. Size of Units: Unless otherwise indicated, 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.

2.14 CLOSERS

A. Modern-Type-with-Cover Surface Closers: Rack-and-pinion hydraulic type; with adjustable sweep and latch speeds controlled by key-operated valves; with forged-steel main arm;

enclosed in cover indicated; complying with the following:

1. Mounting: Parallel arm.

2. Type: Delayed action closing.

3. Backcheck: Adjustable, effective between 60 and 85 degrees of door opening.

4. Cover Material: Aluminum**.**

5. Closing Power Adjustment: At least 35 percent more than minimum tested value.

2.15 PROTECTIVE TRIM UNITS, GENERAL

A. Standard: Comply with BHMA A156.6.

B. Materials: Stainless steel: 0.050 inch (1.3 mm) thick, bevel top and 2 sides.

C. Fasteners: Provide manufacturer's standard exposed fasteners for door trim units consisting of either machine or self-tapping screws.

D. Furnish protection plates sized 1-1/2 inches (38 mm) less than door width on push side and 1/2 inch (13 mm) less than door width on pull side, by height specified in schedule.

2.16 PROTECTIVE TRIM UNITS

A. Mop Plates: 6 inches (152 mm) high by 1 inch (25 mm) less than door width.

1. Material: Aluminum, Brass, Bronze, Stainless steel.

2. Height: 48 inches (1220 mm)42 inches (1067 mm).

2.17 STOPS AND HOLDERS, GENERAL

A. Standards: Comply with the following stops and bumpers: BHMA A 156.16.

1. Stop and Bumpers: BHMA Grade 1, unless Grade 2 is indicated.

B. Silencers for Metal Door Frames: BHMA Grade 1; neoprene or rubber, minimum diameter 1/2 inch (13 mm); fabricated for drilled-in application to frame.

2.18 STOPS AND HOLDERS

A. Wall Bumpers: Polished aluminum with rubber bumper; 2-1/2-inch (64-mm) diameter, minimum 3/4-inch (19-mm) projection from wall, with backplate for concealed fastener installation; with configuration.

B. Dome-Type Floor Stop: Polished aluminum, with rubber bumper; and as follows:

1. Height: Minimum 1 inch (25 mm) high, for doors without threshold 1-3/8 inches (35 mm) high, for doors with threshold.

2. Riser: Extruded aluminum for carpet installations.

2.19 DOOR GASKETING, GENERAL

A. Standard: Comply with BHMA A156.22.

B. General: Provide continuous sound gasketing on interior doors where indicated or scheduled. Provide noncorrosive fasteners

1. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

2. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

C. Air Leakage: Not to exceed 0.50 cfm per foot (0.000774 cu. m/s per m) of crack length for gasketing other than for smoke control, as tested according to ASTM E 283.

D. Smoke-Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke-control ratings indicated, based on testing according to UL 1784.

1. Provide smoke-labeled gasketing on 20-minute-rated doors and on smoke-labeled doors.

E. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated, based on testing according to ASTM E 1408.

F. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

G. Gasketing Materials: Comply with ASTM D 2000 and AAMA 701/702.

2.20 DOOR GASKETING

A. Adjustable, Housed Perimeter Gasketing: Screw-adjustable gasket material held in place by metal housing; fastened to frame stop with screws.

1. Gasket Material: Silicone bulb.

2. Housing Material: Stainless steel.

B. Automatic Door Bottoms: Gasket material held in place by metal housing that automatically drops to form seal when door is closed; mounted to bottom edge of door with screws.

1. Gasket Material: Sponge silicone

2. Housing Material: Aluminum

3. Mounting: Surface mounted on face of door Delete below if not required.

4. Type: Low-closing-force type for doors required to meet accessibility requirements.

2.21 FABRICATION

A. Manufacturer's Nameplate: Do not provide manufacturers' products that have manufacturer's name or trade name displayed in a visible location (omit removable nameplates) except in conjunction with required fire-rated labels and as otherwise approved by Architect.

1. Manufacturer's identification will be permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal, 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 for finishes. Do not furnish manufacturer's standard materials or forming methods if different from specified standard.

C. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to commercially recognized industry standards for application intended. 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.

2.22 FINISHES

A. Standard: Comply with BHMA A156.18.

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.

D. BHMA Designations: Comply with base material and finish requirements indicated by the following:

1. BHMA 628: Satin aluminum, clear anodized, over aluminum base metal.

2. BHMA 630: Satin stainless steel, over stainless-steel base metal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance of door hardware.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

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

3.2 PREPARATION

A. Steel Doors and Frames: Comply with DHI A115 series.

1. Surface-Applied Door Hardware: Drill and tap doors and frames according to SDI 107.

3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."

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 work specified in Division 9 Sections. 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.

3.4 FIELD QUALITY CONTROL

A. Independent Architectural Hardware Consultant: Contractor shall engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.

1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Adjust sweep period 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.

B. Six-Month Adjustment: Approximately six months after date of Substantial Completion, Installer shall perform the following:

1. Examine and readjust each item of door hardware as necessary to ensure function of doors, door hardware, and electrified door hardware.

2. Consult with and instruct government's personnel on recommended maintenance procedures.

3. Replace door hardware items that have deteriorated or failed due to faulty design, materials, or installation of door hardware units.

3.6 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 door hardware is without damage or deterioration at time of Substantial Completion.

3.7 DEMONSTRATION

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

3.8 DOOR HARDWARE SCHEDULE

Door Hardware Set No. 1:

1-1/2 pr	Hinges	A5112 x 4-1/2	626
1	Closer	C02-101	628
2	Mop Plate	J102-6 x34	626
3	Silencers	L03011	Grey
1	Exit device by Government		

Door Hardware Set No. 2

3 pr	Hinges	A5112 x41/2	626
1	Closer	C02101	628
2	Flush Bolts	L04082	626
1	Dust Proof Strike	L04011	626
2	Silencers	L03011	Grey
1	Exit Device by Government		

Door Hardware Set No. 3

1-1/2pr	Hinges	A5112 x41/2	626
1	Lockset	F 86-2	626
1	Closer	L02021	628
2	Mop Plate	J102-6x34	626
3	Silencers	L03011	Grey

Door Hardware Set No. 4

3pr	Hinges	A5112 x41/2	626
1	Lockset	F 86-2	626
1	Closer	L02021	628
2	Flush Bolts	Type 24	630
2	Flush Bolts	L04082	626
2	Mop Plate	J102-6x34	626
1	Dust Proof Strike	L04011	Grey
2	Silencers	L03011	Grey

Door Hardware Set No. 5

1-1/2pr	Hinges	A5112 x41/2	626
1	Lockset	82-2	626
1	Closer	C2021	628
2	Mop Plate	J102-6x34	628
1	Weatherstrip	R5E165	626
		R5E335	
3	Silencers	L03011	Grey

Door Hardware Set No. 6

1-1/2pr	Hinges	A5112 x4 1/2	626
1	Lockset	F75-2	626
1	Mop Plate	J102-6x34	626
1	Weatherstrip	R5E165	626
		R5E165	
3	Silencers	L03011	

Door Hardware Set No. 7

3 pr	Hinges	A5112 x5	626
1	Lockset	F75-2	626
2	Flush Bolts	L04082	626
1	Dust Proof Strike	L04011	626
2	Mop Plate	J102-6x46	626
2	Silencers	L03011	grey

Door Hardware Set No.8

1-1/2 pr	Hinges	A5112 x4 1/2	626
1	Deadlock	E61061	626
1	Closer	C02021	628
1	Push Plate	J303	626
2	Pull Plate	J407	
1	Mop Plate	J102-6-34	626
3	Silencers	L03011	Grey

Door Hardware Set No. 9

3	Hinges	A5112x41/2	626
1	Lockset	F82-2	626
2	Closer	C02021	628
2	Flush Bolts	L04082	626
1	Dust Proof Strike	L04011	626
2	Silencers	L03011	grey

END OF SECTION 08712

SECTION 08800 - GLAZING

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 glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Doors (Interior).
2. Aluminum entrance doors.

B. Related Sections include the following:

1.3 DEFINITIONS

A. Manufacturer: A firm that produces primary glass or fabricated glass as defined in referenced glazing publications.

B. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.

C. Deterioration of Insulating Glass: Failure of the hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for 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.

1.4 PERFORMANCE REQUIREMENTS

A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:

a. Specified Design Wind Loads: Determine design wind loads applicable to Project from basic wind speed indicated in miles per hour (meters per second) at 33 feet (10 m) above grade, according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 6.4.2, "Analytic Procedure," based on mean roof heights above grade indicated on Drawings.

b. Probability of Breakage for Vertical Glazing: 8 lites per 1000 for lites set vertically or not more than 15 degrees off vertical and under wind action.

1) Load Duration: 60 seconds or less.

c. Maximum Lateral Deflection: For the following types of glass supported on all four edges, provide thickness required that limits center deflection at design wind pressure to 1/50 times the short side length or 1 inch (25 mm), whichever is less.

1) For insulating glass.

d. Minimum Glass Thickness for Exterior Lites: Not less than 6 mm.

e. Thickness of Tinted and Heat-Absorbing Glass: Provide the same thickness for each tint color indicated throughout Project.

B. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

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

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

1. For insulating-glass units, properties are based on units with lites 6 mm thick and a nominal 1/2-inch- (13-mm-) wide interspace.

2. Center-of-Glass U-Values: NFRC 100 methodology using LBL-35298 WINDOW 4.1 computer program, expressed as Btu/ sq. ft. x h x deg F (W/sq. m x K).

3. Center-of-Glass Solar Heat Gain Coefficient: NFRC 200 methodology using LBL-35298 WINDOW 4.1 computer program.

4. Solar Optical Properties: NFRC 300.

1.5 SUBMITTALS

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

B. Samples: For the following products, in the form of 12-inch- (300-mm-) square Samples for glass and of 12-inch- (300-mm-) long Samples for sealants. Install sealant Samples between two strips of material representative in color of the adjoining framing system.

C. Samples: For the following products, in the form of 12-inch- (300-mm-) square Samples for glass.

1. Wired glass.

2. Insulating glass for each designation indicated.

D. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.

E. 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.

F. Preconstruction Adhesion and Compatibility Test Report: From glazing sealant manufacturer indicating glazing sealants were tested for adhesion to glass and glazing channel substrates and for compatibility with glass and other glazing materials.

G. Product Test Reports: From a qualified testing agency indicating the following products comply with requirements, based on comprehensive testing of current products:

1. Tinted float glass.
2. Insulating glass.
3. Glazing sealants.
4. Glazing gaskets.

H. SWRI Validation Certificate: For each elastomeric glazing sealant specified to be validated by SWRI's Sealant Validation Program.

I. Warranties: Special warranties specified in this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for Project and whose work has resulted in construction with a record of successful in-service performance.

B. Source Limitations for Clear Glass: Obtain clear float glass from one primary-glass manufacturer.

C. Source Limitations for Insulating Glass: Obtain insulating-glass units from one manufacturer using the same type of glass and other components for each type of unit indicated.

D. Source Limitations for Glazing Accessories: Obtain glazing accessories from one source for each product and installation method indicated.

E. Glass Product Testing: Obtain glass test results for product test reports in "Submittals" Article from a qualified testing agency based on testing glass products.

1. Glass Testing Agency Qualifications: An independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

F. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201 and ANSI Z97.1.

G. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these

publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: GANA'S "Glazing Manual" and SIGMA TB-3001, "Sloped Glazing Guidelines."

H. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following inspecting and testing agency:

1. Insulating Glass Certification Council.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. For insulating-glass units that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written recommendations for venting and sealing to avoid hermetic seal ruptures.

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.

1.9 WARRANTY

A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

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

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products indicated in schedules at the end of Part 3.

B. Products: Subject to compliance with requirements, provide one of the products indicated in schedules at the end of Part 3.

2.2 PRIMARY FLOAT GLASS

A. Float Glass: ASTM C 1036, Type I (transparent glass, flat), Quality q3 (glazing select); class as indicated in schedules at the end of Part 3.

B. Heat-Treated Float Glass: ASTM C 1048; Type I (transparent glass, flat); Quality q3 (glazing select); class, kind, and condition as indicated in schedules at the end of Part 3.

2.3 WIRED GLASS

A. Wired Glass: ASTM C 1036, Type II (patterned and wired glass, flat), Class 1 (clear), Quality q8 (glazing); 6.4 mm thick; of form and mesh pattern indicated below:

1. Polished Wired Glass: Form 1 (wired, polished both sides), and as follows:

2. Mesh m2 (square).

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Polished Wired Glass:

a. Ashai Glass Co./Ama Glass Corp.
b. Central Glass Co., Ltd.
c. Nippon Sheet Glass Co., Ltd.
d. Pilkington Glass Ltd.

2.4 INSULATING GLASS

A. Insulating-Glass Units: Preassembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 774 for Class CBA units and with requirements specified in this Article and in the Insulating-Glass Schedule at the end of Part 3.

B. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated in the Insulating-Glass Schedule at the end of Part 3 are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.

C. Sealing System: Dual seal, with primary and secondary sealants as follows:

1. Manufacturer's standard sealants.

D. Spacer Specifications: Manufacturer's standard spacer material and construction.

2.5 ELASTOMERIC GLAZING SEALANTS

A. General: Provide products of type indicated, complying with the following requirements:

1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

2.6 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 A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions with a Shore A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

2.7 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

A. Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing standard, to comply with system performance requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing glazing, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.

2. Minimum required face or 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.

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. 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.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.

D. 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.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where the length plus width is larger than 50 inches (1270 mm) as follows:

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.

G. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

H. 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.

3.4 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.5 PROTECTION AND CLEANING

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, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended 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 build-up of dirt, scum, alkaline deposits, or stains; remove as recommended by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way, including natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer.

3.6 MONOLITHIC FLOAT-GLASS SCHEDULE

A. Insulating Glass IG-#: Where glass of this designation is indicated, provide insulating-glass units complying with the following:

1. Construction: Provide units that comply with requirements specified for insulating-glass.

2. Color: Bronze tint to match existing glazing.

END OF SECTION 08800

SECTION 09255 - GYPSUM BOARD ASSEMBLIES

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. Nonload-bearing steel framing members for gypsum board assemblies.

2. Gypsum board assemblies attached to steel framing.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 7 Section "Firestopping" for firestopping systems and fire-resistance-rated joint sealants.

1.3 DEFINITIONS

A. Gypsum Board Construction Terminology: Refer to ASTM C 11 and GA-505 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

1.4 ASSEMBLY PERFORMANCE REQUIREMENTS

A. Sound Transmission Characteristics: For gypsum board assemblies with STC ratings, provide materials and construction identical to those of assemblies whose STC ratings were determined according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.

B. Fire Resistance: Provide gypsum board assemblies with fire-resistance ratings indicated.

1.5 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data for each type of product specified.

C. Product certificates signed by manufacturers of gypsum board assembly components certifying that their products comply with specified requirements.

1.6 QUALITY ASSURANCE

A. Single-Source Responsibility for Steel Framing: Obtain steel framing members for gypsum board assemblies from a single manufacturer, unless otherwise indicated.

B. Single-Source Responsibility for Panel Products: Obtain each type of gypsum board and other panel products from a single manufacturer.

C. Single-Source Responsibility for Finishing Materials: Obtain finishing materials from either the same manufacturer that supplies gypsum board and other panel products or from a manufacturer acceptable to gypsum board manufacturer.

D. Fire-Test-Response Characteristics: Where fire-resistance-rated gypsum board assemblies are indicated, provide gypsum board assemblies that comply with the following requirements:

1. Fire-Resistance Ratings: As indicated by GA File Numbers in GA-600 "Fire Resistance Design Manual" or design designations in UL "Fire Resistance Directory" or in the listing of another testing and inspecting agency acceptable to authorities having jurisdiction.

2. Deflection and Firestop Track: Top runner provided in fire-resistance-rated assemblies indicated is labeled and listed by UL, Warnock Hersey, or another testing and inspecting agency acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Neatly stack gypsum panels flat to prevent sagging.

1.8 PROJECT CONDITIONS

A. Environmental Conditions, General: Establish and maintain environmental conditions for applying and finishing gypsum board to comply with ASTM C 840 requirements or gypsum board manufacturer's recommendations, whichever are more stringent.

B. Room Temperatures: For non-adhesive attachment of gypsum board to framing, maintain not less than 40 degrees F (4 degrees C). For adhesive attachment and finishing of gypsum board, maintain not less than 50 degrees F (10 degrees C) for 48 hours before application and continuously after until dry. Do not exceed 95 degrees F (35 degrees C) when using temporary heat sources.

C. Ventilation: Ventilate building spaces as required to dry joint treatment materials. Avoid drafts during hot, dry weather to prevent finishing materials from drying too rapidly.

1.9 STEEL FRAMING COMPONENTS FOR SUSPENDED AND FURRED CEILINGS

A. General: Provide components complying with ASTM C 754 for conditions indicated.

B. Cast-in-Place and Post-installed Anchors in Concrete: Anchors of type indicated below, fabricated from corrosion-resistant materials, with holes or loops for attaching hanger wires, and with capability to sustain, without failure, a load equal to 5 times that imposed by ceiling construction, as determined by testing according to ASTM E 488 conducted by a qualified independent testing agency.

1. Cast-in-place type designed for attachment to concrete forms.
2. Chemical anchor.
3. Expansion anchor.

C. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190 conducted by a qualified independent testing agency.

D. Wire Ties: ASTM A 641 (ASTM A 641M), Class 1 zinc coating, soft temper, 0.062 inch (1.6 mm) thick.

E. Wire Hangers: ASTM A 641 (ASTM A 641M), Class 1 zinc coating, soft temper, 0.162-inch (4.1-mm) diameter.

F. Channels: Cold-rolled steel, 0.0598-inch (1.5-mm) minimum thickness of base (uncoated) metal and 7/16-inch- (11.1-mm-) wide flanges, and as follows:

1. Carrying Channels: 2 inches (50.8 mm) deep, 590 lb/1000 feet (88 kg/100 m), unless otherwise indicated.

2. Furring Channels: 3/4 inch (19.1-mm) deep, 300 lb/1000 feet (45-kg/100 m), unless otherwise indicated.

3. Finish: Rust-inhibitive paint, unless otherwise indicated.

G. Steel Studs for Furring Channels: ASTM C 645, with flange edges of studs bent back 90 degrees and doubled over to form 3/16-inch- (5-mm-) wide minimum lip (return), and complying with the following requirements for minimum thickness of base (uncoated) metal and for depth:

1. Thickness: 0.0329 inch (0.84 mm), unless otherwise indicated.

2. Depth: 3-5/8 inches (92.1 mm), unless otherwise indicated.

3. Protective Coating: Manufacturer's standard corrosion-resistant coating.

H. Steel Rigid Furring Channels: ASTM C 645, hat shaped, depth of 7/8 inch (22.2 mm), and minimum thickness of base (uncoated) metal as follows:

1. Thickness: 0.0329 inch (0.84 mm), unless otherwise indicated.

2. Protective Coating: Manufacturer's standard corrosion-resistant coating.

1.10 STEEL FRAMING FOR WALLS AND PARTITIONS

A. General: Provide steel framing members complying with the following requirements:

1. Protective Coating: Manufacturer's standard corrosion-resistant coating.

B. Steel Studs and Runners: ASTM C 645, with flange edges of studs bent back 90 degrees and

doubled over to form 3/16-inch- (5-mm-) wide minimum lip (return), and complying with the following requirements for minimum thickness of base (uncoated) metal and for depth:

1. Thickness: 0.0329 inch (0.84 mm) as follows:

   a. For head runner, sill runner, jamb, and cripple studs at door and other openings, and where indicated.

2. Thickness: As indicated.

3. Depth: 3-5/8 inches (92.1 mm), unless otherwise indicated.

4. Depth: As indicated.

C. Furring Brackets: Serrated-arm type, adjustable, fabricated from corrosion-resistant steel sheet complying with ASTM C 645, minimum thickness of base (uncoated) metal of 0.0329 inch (0.84 mm), designed for screw attachment to steel studs and steel rigid furring channels used for furring.

D. Steel Channel Bridging: Cold-rolled steel, 0.0598-inch (1.5-mm) minimum thickness of base (uncoated) metal and 7/16-inch- (11.1-mm-) wide flanges, 1-1/2 inches (38.1 mm) deep, 475 lb/1000 feet (45 kg/100 m), unless otherwise indicated.

E. Steel Flat Strap and Backing Plate: Steel sheet for blocking and bracing complying with ASTM A 653 (ASTM A 653M) or ASTM A 568 (ASTM A 568M), length and width as indicated, and with a minimum base metal (uncoated) thickness as follows:

1. Thickness: 0.0329 inch (0.84 mm) where indicated.

F. Fasteners for Metal Framing: Provide fasteners of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel framing and furring members securely to substrates involved; complying with the recommendations of gypsum board manufacturers for applications indicated.

1.11 GYPSUM BOARD PRODUCTS

A. General: Provide gypsum board of types indicated in maximum lengths available that will minimize end-to-end butt joints in each area indicated to receive gypsum board application.

1. Widths: Provide gypsum board in widths of 48 inches (1219 mm).

B. Gypsum Wallboard: ASTM C 36 and as follows:

1. Type: Regular or water resistant for vertical surfaces, unless otherwise indicated.

2. Type: Type X where required for fire-resistance-rated assemblies.

3. Type: Sag-resistant type for ceiling surfaces.

4. Edges: Tapered.

5. Thickness: 1/2 inch (12.7 mm), unless otherwise indicated.

C. Gypsum Board Base Layer(s) for Multilayer Applications: Gypsum wallboard, ASTM C 36, and as follows:

1. 4Type: Regular for vertical surfaces, unless otherwise indicated.

2. Type: Type X where indicated or required for fire-resistance-rated assemblies.

3. Edges: Manufacturer's standard.

4. Thickness: 1/2 inch (12.7 mm), unless otherwise indicated.

1.12 TRIM ACCESSORIES

A. Accessories for Interior Installation: Cornerbead, edge trim, and control joints complying with ASTM C 1047 and requirements indicated below:

1. Material: Formed metal complying with the following requirement:

a. Steel sheet zinc coated by hot-dip process or rolled zinc.

2. Shapes indicated below by reference to Fig. 1 designations in ASTM C 1047:

b. Cornerbead on outside corners, unless otherwise indicated.

c. LC-bead with both face and back flanges; face flange formed to receive joint compound. Use LC-beads for edge trim, unless otherwise indicated.

d. L-bead with face flange only; face flange formed to receive joint compound. Use L-bead where indicated.

e. U-bead with face and back flanges; face flange formed to be left without application of joint compound. Use U-bead where indicated.

f. One-piece control joint formed with V-shaped slot and removable strip covering slot opening.

1.13 JOINT TREATMENT MATERIALS

A. General: Provide joint treatment materials complying with ASTM C 475 and the recommendations of both the manufacturers of sheet products and of joint treatment materials for each application indicated.

B. Joint Tape for Gypsum Board: Paper reinforcing tape, unless otherwise indicated.

1. Use pressure-sensitive or staple-attached, open-weave, glass-fiber reinforcing tape with compatible joint compound where recommended by manufacturer of gypsum board and joint treatment materials for application indicated.

C. Drying-Type Joint Compounds for Gypsum Board: Factory-packaged vinyl-based products complying with the following requirements for formulation and intended use.

1. Ready-Mixed Formulation: Factory-mixed product.

   g. Taping compound formulated for embedding tape and for first coat over fasteners and face flanges of trim accessories.

   h. Topping compound formulated for fill (second) and finish (third) coats.

   i. All-purpose compound formulated for both taping and topping compounds.

1.14 ACOUSTICAL SEALANT

A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, non-staining latex sealant complying with ASTM C 834 and the following requirements:

   1. Product is effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

B. Acoustical Sealant for Concealed Joints: Manufacturer's standard nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce transmission of airborne sound.

C. Available Products: Subject to compliance with requirements, acoustical sealants that may be incorporated in the Work include, but are not limited to, the following:

   1. Acoustical Sealant for Exposed and Concealed Joints:

      a. PL Acoustical Sealant; ChemRex, Inc.; Contech Brands.

      b. AC-20 FTR Acoustical and Insulation Sealant; Pecora Corp.

      c. SHEETROCK Acoustical Sealant; United States Gypsum Co.

   2. Acoustical Sealant for Concealed Joints:

      d. BA-98; Pecora Corp.

      e. Tremco Acoustical Sealant; Tremco, Inc.

1.15 MISCELLANEOUS MATERIALS

A. General: Provide auxiliary materials for gypsum board construction that comply with referenced standards and recommendations of gypsum board manufacturer.

B. Laminating Adhesive: Special adhesive or joint compound recommended for laminating gypsum panels.

C. Spot Grout: ASTM C 475, setting-type joint compound recommended for spot-grouting hollow metal door frames.

D. Fastening Adhesive for Metal: Special adhesive recommended for laminating gypsum panels to

steel framing.

E. Steel drill screws complying with ASTM C 1002 for the following applications:

1. Fastening gypsum board to steel members less than 0.033 inch (0.84 mm) thick.

2. Fastening gypsum board to gypsum board.

F. Steel drill screws complying with ASTM C 954 for fastening gypsum board to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.

G. Sound-Attenuation Blankets: Unfaced mineral-fiber blanket insulation produced by combining mineral fibers of type described below with thermosetting resins to comply with ASTM C 665 for Type I (blankets without membrane facing).

1. Mineral-Fiber Type: Fibers manufactured from glass, slag wool, or rock wool.

H. Thermal Insulation: Material indicated below, of thickness and width to fill voids formed by furring members:

I. e Foil-Faced, Slag-Wool-Fiber Board Insulation: Thermal insulation combining slag-wool or rock-wool fibers with thermosetting resin binders and faced on one side with foil-scrim-kraft or foil-scrim-polyethylene vapor retarder to comply with ASTM C 612 for type and other requirements indicated below; passing ASTM E 136 for combustion characteristics of unfaced board.

1. Nominal density of 4 lb./cu. ft. (64 kg/cu. m), Type IA and IB, thermal resisitivity of 4 degrees F x h x sq. ft./Btu x in. at 75 degrees F (27.7 K x m/W at 24 degrees C).

2. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indices 25 and 5 respectively.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to which gypsum board assemblies attach or abut, installed hollow metal frames, cast-in-anchors, and structural framing, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of assemblies specified in this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Ceiling Anchorages: Coordinate installation of ceiling suspension systems with installation of overhead structural assemblies to ensure that inserts and other provisions for anchorages to building structure have been installed to receive ceiling hangers that will develop their full strength and at spacing required to support ceilings.

1. Furnish concrete inserts and other devices indicated to other trades for installation well in advance of time needed for coordination with other construction.

3.3 INSTALLING STEEL FRAMING, GENERAL

A. Steel Framing Installation Standard: Install steel framing to comply with ASTM C 754 and with ASTM C 840 requirements that apply to framing installation.

B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with recommendations of gypsum board manufacturer or, if none available, with United States Gypsum Co.'s "Gypsum Construction Handbook."

C. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement. Comply with details shown on Drawings.

1. Where building structure abuts ceiling perimeter or penetrates ceiling.

2. Where partition framing and wall furring abut structure, except at floor.

a. Install deflection and firestop track top runner at fire-resistance-rated assemblies where indicated.

1) Attach jamb studs at openings to tracks using manufacturer's standard stud clip.

3.4 INSTALLING STEEL FRAMING FOR SUSPENDED AND FURRED CEILINGS

A. Suspend ceiling hangers from building 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 structural or ceiling suspension system. 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 the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.

3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail.

4. Secure flat, angle, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for structure as well as for type of hanger involved, and in a manner that will not cause them to deteriorate or otherwise fail.

5. Do not support ceilings directly from permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.

6. Do not attach hangers to steel deck tabs.

7. Do not attach hangers to steel roof deck. Attach hangers to structural members.

8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

B. Sway-brace suspended steel framing with hangers used for support.

C. Install suspended steel framing components in sizes and at spacings indicated, but not less than that required by the referenced steel framing installation standard.

1. Wire Hangers: 48 inches (1219 mm) o.c.
2. Carrying Channels (Main Runners): 48 inches (1219 mm) o.c.
3. Furring Channels (Furring Members): 16 inches (406 mm) o.c.
4. Furring Channels (Furring Members): 24 inches (610 mm) o.c.

D. Installation Tolerances: Install steel framing components for suspended ceilings so that cross-furring or grid suspension members are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) as measured both lengthwise on each member and transversely between parallel members.

E. Wire-tie or clip furring members to main runners and to other structural supports as indicated.

3.5 INSTALLING STEEL FRAMING FOR WALLS AND PARTITIONS

A. Install runners (tracks) at floors, ceilings, and structural walls and columns where gypsum board stud assemblies abut other construction.

B. Installation Tolerances: Install each steel framing and furring member so that fastening surfaces do not vary more than 1/8 inch (3 mm) from the plane formed by the faces of adjacent framing.

C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.

1. Cut studs 1/2 inch (13 mm) short of full height to provide perimeter relief.

2. For STC-rated and fire-resistance-rated partitions that extend to the underside of floor/roof slabs and decks or other continuous solid structural surfaces to obtain ratings, install framing around structural and other members extending below floor/roof slabs and decks, as needed, to support gypsum board closures needed to make partitions continuous from floor to underside of solid structure.

D. Terminate partition framing at suspended ceilings where indicated.

E. Install steel studs and furring in sizes and at spacings indicated.

F. Install steel studs so flanges point in the same direction and leading edge or end of each gypsum board panel can be attached to open (unsupported) edges of stud flanges first.

G. Frame door openings to comply with GA-219, and with applicable published recommendations of

gypsum board manufacturer, unless otherwise indicated. Attach vertical studs at jambs with screws either directly to frames or to jamb anchor clips on doorframes; install runner track section (for cripple studs) at head and secure to jamb studs.

1. Install 2 studs at each jamb, unless otherwise indicated.

2. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (12.7-mm) clearance from jamb stud to allow for installation of control joint.

3. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.

H. Frame openings other than door openings to comply with details indicated or, if none indicated, as required for door openings. Install framing below sills of openings to match framing required above door heads.

I. Install thermal insulation as follows:

1. Erect insulation vertically and hold in place with furring members spaced 24 inches (610 mm) o.c.

2. Seal joints in vapor retarders caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor retarder tape.

3. Repair any tears or punctures in vapor retarder immediately before concealing it with the installation of gypsum board or other construction.

3.6 APPLYING AND FINISHING GYPSUM BOARD, GENERAL

A. Gypsum Board Application and Finishing Standards: Install and finish gypsum panels to comply with ASTM C 840 and GA-216.

B. Install sound-attenuation blankets, where indicated, prior to installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

C. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

D. Install gypsum panels with face side out. Do not install imperfect, damaged, or damp panels. 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.

E. Locate both edge or 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. Avoid joints other than control joints at corners of framed openings where possible.

F. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

G. Attach gypsum panels to framing provided at openings and cutouts.

H. Spot grout hollow metal door frames for solid-core wood doors, hollow metal doors, and doors over 32 inches (813 mm) wide. Apply spot grout at each jamb anchor clip and immediately insert gypsum panels into frames.

I. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases that are braced internally.

1. Except where 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 open concrete coffers, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffers, joists, and other structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.

J. Isolate perimeter of nonload-bearing gypsum board partitions at structural abutments, except floors, as detailed. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with U-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

K. Where STC-rated gypsum board assemblies are indicated, seal construction at perimeters, behind control and expansion joints, openings, and penetrations with a continuous bead of acoustical sealant including a bead at both faces of the partitions. Comply with ASTM C 919 and manufacturer's recommendations for location of edge trim and closing off sound-flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.

L. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's recommendations.

1. Space screws a maximum of 12 inches (304.8 mm) o.c. for vertical applications.

M. Space fasteners in panels that are tile substrates a maximum of 8 inches (203.2 mm) o.c.

3.7 GYPSUM BOARD APPLICATION METHODS

A. Single-Layer Application: Install gypsum wallboard panels as follows:

1. On ceilings, apply gypsum panels prior to wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.

2. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated, and provide panel lengths that will minimize end joints.

a. Stagger abutting end joints not less than one framing member in alternate courses of board.

b. At stairwells and other high walls, install panels horizontally.

3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.

B. Wall Tile Substrates: For substrates indicated to receive thin-set ceramic tile and similar rigid applied wall finishes, comply with the following:

1. Install water-resistant gypsum backing board panels where indicated. Install with 1/4-inch (6.4-mm) open space where panels abut other construction or penetrations.

C. Multilayer Application on Partitions/Walls: Apply gypsum board indicated for base layers and gypsum wallboard 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. Stagger joints on opposite sides of partitions.

1. 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.

D. Single-Layer Fastening Methods: Apply gypsum panels to supports as follows:

1. Fasten with screws.

E. Multilayer Fastening Methods: Apply base layers of gypsum panels and face layer to base layers as follows:

1. Fasten both base layers and face layers separately to supports with screws.

3.7 INSTALLING TRIM ACCESSORIES

A. General: For trim accessories with back flanges, fasten to framing with the same fasteners used to fasten gypsum board. Otherwise, fasten trim accessories according to accessory manufacturer's directions for type, length, and spacing of fasteners.

B. Install cornerbead at external corners.

C. Install edge trim where edge of gypsum panels would otherwise be exposed. Provide edge trim type with face flange formed to receive joint compound, except where other types are indicated.

1. Install LC-bead where gypsum panels are tightly abutted to other construction and back flange can be attached to framing or supporting substrate.

2. Install L-bead where edge trim can only be installed after gypsum panels are installed.

3. Install U-bead where indicated.

D. Install control joints according to ASTM C 840 and manufacturer's recommendations and in specific locations approved by COR for visual effect.

3.8 FINISHING GYPSUM BOARD ASSEMBLIES

A. General: Treat gypsum board joints, interior angles, flanges of cornerbead, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration.

B. Prefill open joints, rounded or beveled edges, and damaged areas using setting-type joint compound.

C. Apply joint tape over gypsum board joints, except those with trim accessories having flanges not requiring tape.

D. Apply joint tape over gypsum board joints and to flanges of trim accessories as recommended by trim accessory manufacturer.

E. Levels of Gypsum Board Finish: Provide the following levels of gypsum board finish per GA-214.

1. Level 1 for ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.

2. Level 2 where panels form substrates for tile and where indicated.

3. Level 5 for gypsum board surfaces.

F. Use one of the following joint compound combinations as applicable to the finish levels specified:

1. Embedding and First Coat: Ready-mixed, drying-type, all-purpose or taping compound. Fill (Second) Coat: Ready-mixed, drying-type, all-purpose or topping compound. Finish (Third) Coat: Ready-mixed, drying-type, all-purpose or topping compound.

G. Where Level 5 gypsum board finish is indicated, embed tape in joint compound and apply first, fill (second), and finish (third) coats of joint compound over joints, angles, fastener heads, and accessories; and apply a thin, uniform skim coat of joint compound over entire surface. For skim coat, use joint compound specified for third coat, or a product specially formulated for this purpose and acceptable to gypsum board manufacturer. Touch up and sand between coats and after last coat as needed to produce a surface free of visual defects, tool marks, and ridges and ready for decoration.

H. Where Level 2 gypsum board finish is indicated, embed tape in joint compound and apply first coat of joint compound.

I. Where Level 1 gypsum board finish is indicated, embed tape in joint compound.

J. Finish water-resistant gypsum backing board forming base for ceramic tile to comply with ASTM C 840 and gypsum board manufacturer's directions for treatment of joints behind tile.

3.9 FIELD QUALITY CONTROL

A. Above-Ceiling Observation: COR will conduct an above-ceiling observation prior to installation of gypsum board ceilings and report any deficiencies in the Work observed. Do not proceed with

installation of gypsum board to ceiling support framing until deficiencies have been corrected.

1. Notify COR one week in advance of the date and the time when the Project, or part of the Project, will be ready for an above-ceiling observation.

2. Prior to notifying COR, complete the following in areas to receive gypsum board ceilings:

    a. Installation of 80 percent of lighting fixtures, powered for operation.

    b. Installation, insulation, and leak and pressure testing of water piping systems.

    c. Installation of air duct systems.

    d. Installation of air devices.

    e. Installation of mechanical system control air tubing.

    f. Installation of ceiling support framing.

3.10 CLEANING AND PROTECTION

A. Promptly remove any residual joint compound from adjacent surfaces.

B. Provide final protection and maintain conditions, in a manner acceptable to Installer, which ensures gypsum board assemblies are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 09255

SECTION 09310 - CERAMIC TILE

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. Ceramic wall tile.
2. Ceramic floor tile.
3. Stone thresholds.

B. Related Sections include the following:

1. Division 7 Section "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.

2. Division 9 Section "Gypsum Board Assemblies" for ceramic tile wall base.

1.3 DEFINITIONS

A. Module Size: Actual tile size (minor facial dimension as measured per ASTM C 499) plus joint width indicated.

B. Facial Dimension: Actual tile size (minor facial dimension as measured per ASTM C 499).

C. Facial Dimension: Nominal tile size as defined in ANSI A137.1.

1.4 PERFORMANCE REQUIREMENTS

A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:

1. Level Surfaces: Minimum 0.6.
2. Step Treads: Minimum 0.6.

B. Load-Bearing Performance: For ceramic tile installed on walkway surfaces, provide installations rated for the following load-bearing performance level based on testing assemblies according to ASTM C 627 that are representative of those indicated for this Project:

1. Moderate: Passes cycles 1 through 10.

1.5 SUBMITTALS

A. Product Data: For each type of tile, mortar, grout, and other products specified.

B. Shop Drawings: For the following:

1. Tile patterns and locations.

2. Widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

C. Tile Samples for Initial Selection: Samples of units as scheduled on the drawings.

D. Grout Samples for Initial Selection: Manufacturer's color charts consisting of actual sections of grout showing the full range of colors available for each type of grout indicated.

1. Stone thresholds in 6-inch (150-mm) lengths.

E. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

F. Product Certificates: Signed by manufacturers certifying that the products furnished comply with requirements.

G. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names of architects and owners, and other information specified.

H. Tile Test Reports: Indicate and interpret test results for compliance of special-purpose tile with specified requirements.

I. Setting Material Test Reports: Indicate and interpret test results for compliance of tile-setting and -grouting products with specified requirements.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who has completed tile installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Source Limitations for Tile: Obtain each color, grade, finish, type, composition, and variety of tile from one source with resources to provide products from the same production run for each contiguous area of consistent quality in appearance and physical properties without delaying the Work.

C. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.

D. Source Limitations for Other Products: Obtain each of the following products specified in this Section from one source and by a single manufacturer for each product:

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."

1.7 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 requirement of ANSI A137.1 for labeling sealed tile packages.

B. Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.

C. Handle tile with 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.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is completed and ambient temperature and humidity conditions are being maintained to comply with referenced standards and manufacturer's written instructions.

1.9 EXTRA MATERIALS

A. Deliver extra materials to Owner. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are 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.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard Grade requirements, unless otherwise indicated.

2. For facial dimensions of tile, comply with requirements relating to tile sizes specified in Part 1 "Definitions" Article.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI standards referenced in "Setting Materials" and "Grouting Materials" articles.

C. Colors, Textures, and Patterns: Where manufacturer's standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with the following requirements:

1. Provide tile trim and accessories.

D. Factory Blending: For tile exhibiting color variations within the ranges selected during Sample submittals, blend tile in the factory and package so tile units taken from one package show the same range in colors as those taken from other packages and match approved Samples.

E. Mounting: Where factory-mounted tile is required, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless another mounting method is indicated.

F. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating them with a continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.2 TILE PRODUCTS

A. Tile for floors and walls shall be as scheduled on the drawings and match those installed in the basement and or the fourth floor.

2.3 STONE THRESHOLDS

A. General: Provide stone thresholds that are uniform in color and finish, fabricated to sizes and profiles indicated to provide transition between tile surfaces and adjoining finished floor surfaces.

1. Fabricate thresholds to heights indicated, but not more than 1/2 inch (12.7 mm) above adjoining finished floor surfaces, with transition edges beveled on a slope of no greater than 1:2.

B. Marble Thresholds: Provide marble thresholds complying with ASTM C 503 requirements for exterior use and with a minimum abrasive-hardness value of 10 per ASTM C 241.

1. Provide units which match those in the basement and on the fourth floor.

2.4 SETTING MATERIALS

A. Dry-Set Portland Cement Mortar: ANSI A118.1.

1. For floor and wall applications, provide nonsagging, latex-portland cement mortar complying with ANSI A118.4 for mortar of this type defined in Section F-2.1.2.

2.5 GROUTING MATERIALS

A. Latex-Portland Cement Grout: ANSI A118.6 for materials described in Section H-2.4, composed as follows:

1. Factory-Prepared, Dry-Grout Mixture: Factory-prepared mixture of portland cement; dry, redispersible, ethylene vinyl acetate additive; and other ingredients to produce the following:

a. Unsanded grout mixture for joints 1/8 inch (3.2 mm) and narrower.

b. Sanded grout mixture for joints 1/8 inch (3.2 mm) and wider.

2.6 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Temporary Protective Coating: Provide product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; is compatible with tile, mortar, and grout products; and is easily removable after grouting is completed without damaging grout or tile.

1. Petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 120 to 140 deg F (49 to 60 deg C) per ASTM D 87.

2. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as a temporary protective coating for tile.

C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

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 from oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 series of tile installation standards 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 before installing tile.

3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust latter in consultation with Architect.

B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove coatings, including curing compounds, adhesives, and other substances that are incompatible with tile-setting materials to bare concretes by using a terrazzo or concrete grinder, a drum sander, or a polishing machine equipped with a heavy-duty wire brush.

B. Provide concrete substrates for tile floors installed with dry-set or latex-portland cement mortars that comply with flatness tolerances specified in referenced ANSI A108 series of tile installation standards for installations indicated.

1. Use trowelable leveling and patching compounds per tile-setting material manufacturer's written instructions to fill cracks, holes, and depressions.

2. Remove protrusions, bumps, and ridges by sanding or grinding.

C. Blending: For tile exhibiting color variations within the ranges selected during Sample submittals, verify that tile has been blended in the factory and packaged so tile units taken from one package show the same range in colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

D. Field-Applied Temporary Protective Coating: Where indicated under tile type or needed to prevent adhesion or staining of exposed tile surfaces by grout, protect exposed surfaces of tile against adherence of mortar and grout by precoating them with a continuous film of temporary protective coating indicated below, taking care not to coat unexposed tile surfaces:

1. Petroleum paraffin wax or grout release.

3.3 INSTALLATION, GENERAL

A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 series of tile installation standards in "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.

B. TCA Installation Guidelines: TCA's "Handbook for Ceramic Tile Installation." Comply with TCA installation methods indicated in ceramic tile installation schedules.

C. Extend tile work into recesses and under or behind equipment and fixtures to form a complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

D. 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.

E. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are the same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.

1. For tile mounted in sheets, make joints between tile sheets the same width as joints within tile sheets so joints between sheets

are not apparent in finished work.

F. Sealant Filled Joints: Locate joints, including control, contraction, and isolation joints, where indicated during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Locate joints in tile surfaces directly above joints in concrete substrates.

2. Prepare joints and apply sealants to comply with requirements of Division 7 Section "Joint Sealants."

G. Grout tile to comply with the requirements of the following tile installation standards:

1. For ceramic tile grouts (sand-portland cement, dry-set, commercial portland cement, and latex-portland cement grouts), comply with ANSI A108.10.

3.4 FLOOR TILE INSTALLATION

A. General: Install tile to comply with requirements in the Ceramic Tile Floor Installation Schedule, including those referencing TCA installation methods and ANSI A108 series of tile installation standards.

B. Joint Widths: Install tile on floors with the following joint widths:

1. Ceramic Mosaic Tile: 1/16 inch (1.6 mm).
2. Quarry Tile: 1/4 inch (6.35 mm).

C. Stone Thresholds: Install stone thresholds at locations indicated; set in same type of setting bed as abutting field tile, unless otherwise indicated.

3.5 WALL TILE INSTALLATION

A. Install types of tile designated for wall installations to comply with requirements in the Ceramic Tile Wall Installation Schedule, including those referencing TCA installation methods and ANSI setting-bed standards.

B. Color: Wall field color with 3 continuous accent strips.

C. Joint Widths: Install tile on walls with the following joint widths:

1. Ceramic Mosaic Tile: 1/16 inch (1.6 mm).

3.6 CLEANING AND PROTECTING

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove latex-portland cement grout residue from tile as soon as possible.

2. Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Protect metal surfaces, cast iron, and vitreous plumbing fixtures from effects of acid cleaning. Flush surface with clean water before and after cleaning.

3. Remove temporary protective coating by method recommended by coating manufacturer that is acceptable to brick and grout manufacturer. Trap and remove coating to prevent it from clogging drains.

B. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded, and otherwise defective tile work.

C. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure tile is without damage or deterioration at the time of Substantial Completion.

1. When recommended by tile manufacturer, apply a protective coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.

2. Prohibit foot and wheel traffic from tiled floors for at least 7 days after grouting is completed.

D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

END OF SECTION 09310

SECTION 09511 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes ceilings consisting of acoustical panels and exposed suspension systems.

1.3 SUBMITTALS

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

B. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:

1. Ceiling suspension system members.

2. Method of attaching suspension system hangers to building structure.

3. Ceiling-mounted items including light fixtures; air outlets and inlets; speakers; sprinklers; and special moldings at walls, column penetrations, and other junctures of acoustical ceilings with adjoining construction.

4. Minimum Drawing Scale: 1/4 inch = 1 foot (1:48).

C. Samples for Initial Selection: Manufacturer's color charts consisting of actual acoustical panels or sections of acoustical panels, suspension systems, and moldings showing the full range of colors, textures, and patterns available for each type of ceiling assembly indicated.

D. 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.

E. Product Test Reports: Indicate compliance of acoustical panel ceilings and components with requirements based on comprehensive testing of current products.

F. Research/Evaluation Reports: Evidence of acoustical panel ceiling's and components' compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who has completed acoustical panel ceilings similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Source Limitations for Ceiling Units: Obtain each acoustical ceiling panel from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

C. Source Limitations for Suspension System: Obtain each suspension system from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

1. Obtain both acoustical ceiling panels and suspension system from the same manufacturer.

D. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:

1. Surface-burning characteristics of acoustical panels comply with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84.

2. Products are identified with appropriate markings of applicable testing and inspecting agency.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels and suspension system components to Project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, 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.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.7 COORDINATION

A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.8 EXTRA MATERIALS

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

1. Acoustical Ceiling Units: Full-size units equal to 4.0 percent of amount installed.

2. Suspension System Components: Quantity of each exposed component equal to 4.0 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, those indicated for each designation in the Acoustical Panel Ceiling Schedule at the end of Part 3.

2.2 ACOUSTICAL PANELS, GENERAL

A. 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 Noise Reduction Coefficient: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface per ASTM E 795.

B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

1. Where appearance characteristics of acoustical panels are indicated by referencing ASTM E 1264 pattern designations and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range of products that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

C. Panel Characteristics: Comply with requirements indicated in the Acoustical Panel Ceiling Schedule at the end of Part 3, including those referencing ASTM E 1264 classifications.

2.3 METAL SUSPENSION SYSTEMS, GENERAL

A. Metal Suspension System Standard: Provide manufacturer's standard intermediate duty direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable ASTM C 635 requirements.

B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.

B. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung, unless otherwise indicated.

1. Cast-in-Place and Postinstalled Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing per ASTM E 488, conducted by a qualified testing and inspecting agency.

    a. Type: Cast-in-place anchors.

    b. Type: Postinstalled expansion anchors.

    c. Type: Chemical anchors.

    d. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC service condition (mild).

2. Postinstalled Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.

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. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, Direct Hung) will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.

D. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.

E. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

F. 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.

G. Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material and finish as that used for exposed flanges of suspension system runners.

1. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.

2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

3. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating;

Organic Coating: as specified below). Comply with paint manufacturer's written instructions for applying and baking and for minimum dry film thickness.

a. Organic Coating: Manufacturer's standard thermosetting coating system with a minimum dry film thickness of 0.8 to 1.2 mils (0.02 to 0.03 mm).

b. Color: As selected by C.O.R. from manufacturer's standard colors.

2.4 ACOUSTICAL SEALANT

A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and the following requirements:

1. Product is effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

B. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Acoustical Sealant for Exposed and Concealed Joints:

a. PL Acoustical Sealant; Chemrex, Inc., Contech Brands.
b. AC-20 FTR Acoustical and Insulation Sealant; Pecora Corp.
c. SHEETROCK Acoustical Sealant; United States Gypsum Co.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and 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 other conditions affecting performance of acoustical panel ceilings.

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

3.2 PREPARATION

A. Coordination: Furnish layouts for cast-in-place anchors, clips, and other ceiling anchors whose installation is specified in other Sections.

1. Furnish cast-in-place anchors and similar devices to other trades for installation well in advance of time needed for coordinating other work.

B. 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 publications referenced below per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

1. Standard for Ceiling Suspension System Installation:

a. Comply with ASTM C 636.

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. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

4. 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. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

5. 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; that are appropriate for substrate; and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.

6. 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 structure to which hangers are attached and 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.

7. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, powder-actuated fasteners, or drilled-in anchors that extend through forms into concrete.

8. Do not attach hangers to steel deck tabs.

9. Do not attach hangers to steel roof deck. Attach hangers to structural members.

10. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; and provide hangers not more than 8 inches (200 mm) from ends of each member.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without

attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m). Miter corners accurately and connect securely.

3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fitted 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. Install panels in a basket-weave pattern.

2. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.

3. Paint cut panel edges remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: The contractor will engage a qualified independent testing agency to perform field quality-control testing.

B. Extent and Testing Frequency: Testing will take place in successive stages in areas described below. Proceed with installation of acoustical panel ceilings only after test results for previously installed hangers comply with requirements.

1. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion but no panels have been installed.

2. Within each test area, testing agency will select one of every 10 powder-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf (890 N) of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf (1957 N) of tension.

3. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 consecutively pass and then will resume initial testing frequency.

C. Testing agency will report test results promptly and in writing to Contractor and C.O.R.

D. Remove and replace those fasteners and anchors that test results indicate do not comply with specified requirements.

E. Additional Testing: Where fasteners and anchors are removed and replaced, additional testing will be performed to determine compliance with specified requirements.

3.5 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

3.6 ACOUSTICAL PANEL CEILING SCHEDULE

A. Provide panels and suspension system to match existing basement and fourth floors.

1. Acoustical Panels: Provide panels complying with ASTM E 1264 for characteristics described below:

a. Panels: Armstrong, “Optima Open Plan”, Tegular 2’-0” (600 mm).
b. Grid: Armstrong “Sonata” 9/16” DIM (14 mm).

END OF SECTION 09511

SECTION 09651 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Vinyl composition floor tile.
2. Resilient wall base and accessories.

B. Related Sections include the following:

1.3 SUBMITTALS

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

B. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors and patterns available for each type of product indicated.

1. For resilient accessories, manufacturer's standard-size samples, but not less than 12 inches (300 mm) long, of each resilient accessory color and pattern specified.

D. Product Certificates: Signed by manufacturers of resilient products certifying that each product furnished complies with requirements.

E. Maintenance Data: For resilient floor tile to include in the maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer to perform work of this Section who has specialized in installing resilient products similar to those required for this Project and with a record of successful in-service performance.

B. Source Limitations: Obtain each type, color, and pattern of product specified from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to Project site in manufacturer's original, unopened cartons and containers, each bearing names of product and manufacturer, Project identification, and shipping and handling instructions.

B. Store products in dry spaces protected from the weather, with ambient temperatures maintained between 50 and 90 deg F (10 and 32 deg C).

C. Store tiles on flat surfaces.

D. Move products into spaces where they will be installed at least 48 hours before installation, unless longer conditioning period is recommended in writing by manufacturer.

1.6 PROJECT CONDITIONS

A. Maintain a temperature of not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C) in spaces to receive products for at least 48 hours before installation, during installation, and for at least 48 hours after installation, unless manufacturer's written recommendations specify longer time periods. After postinstallation period, maintain a temperature of not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

B. Do not install products until they are at the same temperature as the space where they are to be installed.

C. Close spaces to traffic during flooring installation and for time period after installation recommended in writing by manufacturer.

D. Install tiles and accessories after other finishing operations, including painting, have been completed.

1.7 EXTRA MATERIALS

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

1. Furnish not less than one box for each 50 boxes or fraction thereof, of each type, color, pattern, class, wearing surface, and size of resilient tile flooring installed.

2. Furnish not less than 10 linear feet (3 linear m) for each 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient accessory installed.

3. Deliver extra materials to government.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, those indicated in the Resilient Tile Flooring Schedule at the end of Part 3.

2.2 RESILIENT TILE

A. Vinyl Composition Floor Tile: Products complying with ASTM F 1066 and with requirements specified in the Resilient Tile Flooring Schedule.

2.3 RESILIENT ACCESSORIES

A. Vinyl Wall Base: Products complying with FS SS-W-40, Type II and with requirements specified in the Resilient Tile Flooring Schedule.

B. Vinyl Accessory Moldings: Products complying with requirements specified in the Resilient Tile Flooring Schedule.

2.4 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by flooring manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where installation of resilient products will occur, with Installer present, for compliance with manufacturer's requirements. Verify that substrates and conditions are satisfactory for resilient product installation and comply with requirements specified.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by flooring manufacturer.

2. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

C. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with resilient product manufacturer's written installation instructions for preparing substrates indicated to receive resilient products.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.

D. Remove coatings, including adhesives, curing compounds, and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

E. Broom and vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.3 TILE INSTALLATION

A. General: Comply with tile manufacturer's written installation instructions.

B. Lay out 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 of a tile at perimeter.

1. Lay tiles square with room axis, unless otherwise indicated.

C. Match tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Cut tiles neatly around all fixtures. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles in basket-weave pattern with grain direction alternating in adjacent tiles.

D. Scribe, cut, and fit tiles to butt neatly and tightly to vertical surfaces and permanent fixtures, including built-in furniture, cabinets, pipes, outlets, edgings, door frames, thresholds, and nosings.

E. Extend tiles into toe spaces, door reveals, closets, 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 chalk or other nonpermanent, nonstaining marking device.

H. Adhere tiles to flooring substrates using a full spread of adhesive applied to substrate to comply with tile manufacturer's written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.

1. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

I. Hand roll tiles according to tile manufacturer's written instructions.

3.4 RESILIENT ACCESSORY INSTALLATION

A. General: Install resilient accessories according to manufacturer's written installation instructions.

B. Apply resilient wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

1. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

2. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

3. Do not stretch base during installation.

4. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.

5. Install premolded outside and inside corners before installing straight pieces.

C. Place resilient accessories so they are butted to adjacent materials and bond to substrates with adhesive. Install reducer strips at edges of flooring that would otherwise be exposed.

D. Apply resilient products to stairs as indicated and according to manufacturer's written installation instructions.

3.5 CLEANING AND PROTECTING

A. Perform the following operations immediately after installing resilient products:

1. Remove adhesive and other surface blemishes using cleaner recommended by resilient product manufacturers.

2. Sweep or vacuum floor thoroughly.

3. Do not wash floor until after time period recommended by flooring manufacturer.

4. Damp-mop floor to remove marks and soil.

B. Protect flooring against mars, marks, indentations, and other 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 flooring manufacturer.

1. Apply protective floor polish to floor surfaces that are free from soil, visible adhesive, and surface blemishes, if recommended in writing by manufacturer.

a. Use commercially available product acceptable to flooring manufacturer.

2. Cover products installed on floor surfaces with undyed, untreated building paper until inspection for Substantial Completion.

3. Do not move heavy and sharp objects directly over floor surfaces. Place plywood or hardboard panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.

C. Clean floor surfaces not more than 4 days before dates scheduled for inspections intended to establish date of Substantial Completion in each area of Project. Clean products according to manufacturer's written recommendations.

1. Before cleaning, strip protective floor polish that was applied after completing installation only if required to restore polish finish and if recommended by flooring manufacturer.

2. After cleaning, reapply polish to floor surfaces to restore protective floor finish according to flooring manufacturer's written recommendations. Coordinate with Owner's maintenance program.

3.6 RESILIENT TILE FLOORING SCHEDULE

A. Provide tiles and base to match existing in the basement and fourth floors:

1. Vinyl Composition Tile: Armstrong. “Imperial Texture” standard excelon.

2. Resilient Wall Base: Johnsonite, 4” (100 mm) straight base.

    a. Outside corners: pre-molded.
    b. Inside Corners: pre-molded.

END OF SECTION 09651

SECTION 09680 - CARPET

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 broad 100 m carpet and carpet tile for direct glue down installation.

B. Related Sections include the following:

1. Division 2 Section "Selective Demolition" for removing existing floor coverings.

2. Division 2 Section "Carpet Reclamination" for salvage of existing carpet.

3. Division 9 Section "Resilient Wall Base and Accessories" for resilient wall base and accessories installed with carpet tile.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation methods.

B. Shop Drawings: Show the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.

2. Carpet type, color, and dye lot.

3. Type of installation.

4. Pattern type, location, and direction.

5. Pile direction.

6. Type, color, and location of edge, transition, and other accessory strips.

7. Transition details to other flooring materials.

C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Broad 100 m carpet: 24” x 24” (600 mm x 600 mm) samples.

2. Carpet Tile: Full-size Sample.

3. Exposed Edge Stripping and Accessory: 12-inch- (300-mm-) long Samples.

D. Product Schedule: Use same room and product designations indicated on Drawings and in schedules.

E. Maintenance Data: For carpet tile to include in maintenance manuals specified in Division 1. 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.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.

B. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

A. General: Comply with CRI 104, Section 5, "Storage and Handling."

1.6 PROJECT CONDITIONS

A. General: Comply with CRI 104, Section 6.1, "Site Conditions; Temperature and Humidity."

B. Environmental Limitations: Do not install carpet tile until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.7 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Government of other rights Government may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Carpet Tile Warranty: Written warranty, signed by carpet tile manufacturer agreeing to replace carpet tile that does not comply with requirements or that fails within specified warranty period. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, and delamination.

1. Warranty Period: Tens (10) years from date of Substantial Completion.

1.8 EXTRA MATERIALS

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

1. Carpet 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).

PART 2 - PRODUCTS

2.1 CARPET TILE CPT-1 and CPT-2.

A. Available Manufacture: Subject to compliance with requirements, manufacturer products that may be incorporated into the Work include, but are not limited to, the following: Carpet shall match similar materials installed in the basement and fourth floors.

1. Shaw Contract.

B. Products: Subject to compliance with requirements, provide the following:

Style name:	sargasso
Style number:	60873
Color name:	coral
Color number:	73500
Construction:	multi-level pattern cut/loop
Fiber product:	100% Eco Solution Q® BCF Nylon by Shaw Industries
Protective treatment(s):	S.S.P.® Shaw Soll Protection, Florsept Antimicrobial
Gauge:	1/10
Stitches:	14.0
Production yarn weight:	32.0 ozs./yd^3
Finished pile thickness:	165 inches
Average density:	6,617 ozs/ yd^3
Weight density:	218,144
Dye method	solution dyed
Secondary backing:	polypropyfene
Tufted pattern repeat:	12” w x 24”

2.2 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided by or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, non-staining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and that is recommended by carpet tile manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Verify that substrates and conditions are satisfactory for carpet tile installation and comply with requirements specified.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of adhesive, 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. 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 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, and depressions in substrates.

C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. General: Comply with CRI 104, Section 13, "Carpet Modules (Tiles)." Comply with CRI 104, section 8, “Direct Glue Down Installation”.

B. 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.

C. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

D. 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.

E. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:

1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.

2. Remove yarns that protrude from carpet tile surface.

3. Vacuum carpet tile using commercial machine with face-beater element.

B. Protect installed carpet tile to comply with CRI 104, Section 15, "Protection of 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 09681

SECTION 09900 - PAINTING

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 surface preparation and field painting of the following:

1. Exposed exterior items and surfaces.

2. Exposed interior items and surfaces.

3. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.

B. Paint exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural. If the paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors. If the schedules do not indicate color or finish, the COTR will select from standard colors and finishes available.

1. Painting includes field painting of exposed bare and covered pipes and ducts (including color-coding), hangers, exposed steel and ironwork, and primed metal surfaces of mechanical and electrical equipment.

C. Do not paint pre-finished items, concealed surfaces, finished metal surfaces, operating parts, and labels.

1.3 DEFINITIONS

A. General: Standard-coating terms defined in ASTM D 16 apply to this Section.

1. Semigloss refers to medium-sheen finish with a gloss range between 30 and 65 when measured at a 60-degreesree meter.

1.4 SUBMITTALS

A. Product Data: For each paint system specified. Include block fillers and primers.

1. Material List: Provide an inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.

2. Manufacturer's Information: Provide manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each

coating material proposed for use.

3. Certification by the manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).

B. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for each type of finish-coat material indicated.

C. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of COTRs and Government, and other information specified.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material and extent to that indicated for this Project with a record of successful in-service performance.

B. Source Limitations: Obtain block fillers, primers, and undercoat materials for each coating system from the same manufacturer as the finish coats.

C. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample of each type of coating and substrate required on the Project. Comply with procedures specified in PDCA P5. Duplicate finish of approved prepared samples.

1. The COTR will select one room or surface to represent surfaces and conditions for each type of coating and substrate to be painted.

a. Wall Surfaces: Provide samples on at least 9-sq. m of wall surface.

b. Small Areas and Items: The COTR will designate an item or area as required.

2. After permanent lighting and other environmental services have been activated, apply coatings in this room or to each surface according to the Schedule or as specified. Provide required sheen, color, and texture on each surface.

a. After finishes are accepted, the COTR will use the room or surface to evaluate coating systems of a similar nature.

3. Final approval of colors will be from job-applied samples.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the Project Site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:

1. Product name or title of material.
2. Product description (generic classification or binder type).
3. Manufacturer's stock number and date of manufacture.
4. Contents by volume, for pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.

7. Color name and number.
8. VOC content.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 7 degrees C. Maintain containers used in storage in a clean condition, free of foreign materials and residue.

1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.7 PROJECT CONDITIONS

A. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 and 95 degrees F.

B. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 degrees F above the dew point; or to damp or wet surfaces.

1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

1.8 EXTRA MATERIALS

A. Furnish extra paint materials from the same production run as the materials applied in the quantities described below. Package paint materials in unopened, factory-sealed containers for storage and identify with labels describing contents. Deliver extra materials to the Government.

1. Quantity: Furnish the Government with extra paint materials in the quantities indicated below:

a. Interior, Semigloss Acrylic Enamel: 2 gallons of each color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products in the paint schedules.

B. Manufacturer's Names: The following manufacturers are referred to in the paint schedules by use of shortened versions of their names, which are shown in parentheses:

1. Devoe & Raynolds Co. (Devoe).
2. Fuller-O'Brien Paints (Fuller).
3. Glidden Co. (The) (Glidden).
4. Benjamin Moore & Co. (Moore).
5. PPG Industries, Inc. (PPG).
6. Pratt & Lambert, Inc. (P & L).

7. Sherwin-Williams Co. (S-W).

2.2 PAINT MATERIALS, GENERAL

A. Material Compatibility: Provide block fillers, primers, undercoats, and finish-coat materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

C. Colors: Match colors indicated by reference to manufacturer's color designations.

D. Colors: Provide color selections made by the COTR.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with the Applicator present, under which painting will be performed for compliance with paint application requirements.

1. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.

2. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.

B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

1. Notify the COTR about anticipated problems using the materials specified over substrates primed by others.

3.2 PREPARATION

A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

B. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease before cleaning.

1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and reprime.

2. Cementitious Materials: Prepare concrete, concrete masonry block, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.

a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.

b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's written instructions.

c. Clean concrete floors to be painted with a 5 percent solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before painting.

3. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with the Steel Structures Painting Council's (SSPC) recommendations.

a. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat.

D. Materials Preparation: Mix and prepare paint materials according to manufacturer's written instructions.

1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.

2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.

3. Use only thinners approved by paint manufacturer and only within recommended limits.

E. Tinting: Tint each undercoats a lighter shade to simplify identification of each coat when multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.

1. Paint colors, surface treatments, and finishes are indicated in the schedules.

2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.

3. Provide finish coats that are compatible with primers used.

4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.

5. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.

B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. The number of coats and the film thickness required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.

2. Omit primer on metal surfaces that have been shop primed and touchup painted.

3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.

C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

1. Brushes: Use brushes best suited for the type of material applied. Use brush of

appropriate size for the surface or item being painted.

2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.

3. Spray Equipment: Use airless spray equipment with orifice size as recommended by the manufacturer for the material and texture required.

D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.

E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and in occupied spaces.

F. Mechanical items to be painted include, but are not limited to, the following:

1. Piping, pipe hangers, and supports.
2. Accessory items.

G. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

H. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.

I. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

J. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.4 FIELD QUALITY CONTROL

A. The Government may direct the Contractor to stop painting if material being used does not comply with specified requirements. The Contractor shall remove non-complying paint from the site, and repaint surfaces previously coated with the rejected paint. If necessary, the Contractor may be required to remove rejected paint from previously painted surfaces if, on repainting with specified paint, the 2 coatings are incompatible.

3.5 CLEANING

A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.

1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

3.6 PROTECTION

A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by COTR.

B. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.

1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.7 EXTERIOR PAINT SCHEDULE

A. Concrete Masonry Units: Provide the following finish systems over exterior concrete masonry units:

1. Low-Luster Acrylic Finish: 2 finish coats over a block filler.

a. Block Filler: High-performance, latex block filler applied at spreading rate recommended by the manufacturer to achieve a total dry mill thickness of not less than 4.0 mils.

1) Devoe: 52902 Bloxfil 200 Interior/Exterior Latex Block Filler.

2) Fuller: 280-00 Interior/Exterior Latex Block Filler.

3) Glidden: 5317 Ultra-Hide Block Filler Latex Interior-Exterior.

4) Moore: Moorcraft Interior & Exterior Block Filler #173.

5) PPG: 6-7 Speedhide Interior/Exterior Masonry Latex Block Filler.

6) P & L: Z/F 98 Pro-Hide Plus Block Filler.

b. First and Second Coats: Low-luster (eggshell or satin), exterior, acrylic-latex paint applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.3 mils.

1) Devoe: 16XX Wonder-Shield Exterior Acrylic Latex Satin House and Trim Paint.

2) Fuller: 261-XX Eggshell Sheen Latex House and Trim Paint.

3) Glidden: 6700 Series Spred Ultra Exterior Satin Latex House and Trim Paint.

4) Moore: MoorGard Latex House Paint #103.

5) PPG: 76 Line Sun-Proof Exterior House & Trim Acrylic Satin Latex.

6) P & L: Z/F 1800 Series Aqua-Shell Exterior Latex Eggshell Paint.

B. Ferrous Metal: Provide the following finish systems over exterior ferrous metal. Primer is not required on shop-primed items.

1. Full-Gloss, Alkyd-Enamel Finish: 2 finish coats over a rust-inhibitive primer.

a. Primer: Rust-inhibitive metal primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mil.

1) Devoe: 13101 Mirrolac Rust Penetrating Metal Primer.

2) Fuller: 621-04 Blox-Rust Alkyd Metal Primer.

3) Glidden: 5205 Glid-Guard Tank & Structural Primer, Red.

4) Moore: IronClad Retardo Rust-Inhibitive Paint #163.

5) PPG: 6-208 Speedhide Interior/Exterior Rust Inhibitive Steel Primer.

6) P & L: S 4551 Tech-Gard High Performance Rust-Inhibitor Primer.

7) S-W: Kem Kromik Metal Primer B50N2/B50W1.

b. First and Second Coats: Full-gloss, exterior, alkyd enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 3.0 mil.

1) Devoe: 70XX Mirrolac Interior/Exterior Alkyd-Urethane Gloss Enamel.

2) Fuller: 312-XX Heavy-Duty Industrial Maintenance Enamel.

3) Glidden: 4500 Series Glid-Guard Alkyd Industrial Enamel.

4) Moore: Impervo Enamel #133.

5) PPG: 6-282 Speedhide Interior/Exterior Gloss-Oil Enamel.

6) P & L: S 4500 Series Tech-Gard Maintenance Gloss Enamel.

7) S-W: Industrial Enamel B-54 Series.

3.8 INTERIOR PAINT SCHEDULE

A. Concrete Masonry Units: Provide the following finish systems over interior concrete masonry block units:

1. Semigloss, Alkyd-Enamel Finish: 2 finish coats over an undercoat and a filled surface.

a. Block Filler: High-performance, latex-based, block filler applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 5 mil.

1) Devoe: 52902 Bloxfil 200 Interior/Exterior Latex Block Filler.

2) Fuller: 280-00 Interior/Exterior Latex Block Filler.

3) Glidden: 5317 Ultra-Hide Block Filler, Latex Interior-Exterior.

4) Moore: Moorcraft Interior & Exterior Block Filler #173.

5) PPG: 6-7 Speedhide Interior/Exterior Masonry Latex Block Filler.

6) P & L: Z 98 Pro-Hide Plus Latex Block Filler.

7) S-W: Heavy-Duty Block Filler B42W46.

b. Undercoat: Interior, alkyd- or latex-based, enamel undercoater, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mil.

1) Devoe: 26XX Velour Interior Alkyd Semi-Gloss Enamel.

2) Fuller: 220-07 Interior Alkyd Enamel Undercoat.

3) Glidden: UH 400 Ultra-Hide Alkyd Interior Enamel Undercoater.

4) Moore: Moore's Alkyd Enamel Underbody #217.

5) PPG: 6-855 Speedhide Interior Latex Enamel Undercoater.

6) P & L: S/D 1012 Suprime "12" Interior Alkyd Wall Primer.

7) S-W: Classic 99 Interior/Exterior Semi-Gloss Alkyd Enamel A-40 Series.

c. Finish Coat: Odorless, semigloss, alkyd, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.5 mil.

1) Devoe: 26XX Velour Interior Alkyd Semi-Gloss Enamel.

2) Fuller: 206-XX Interior Alkyd Semi-Gloss Enamel.

3) Glidden: UH 8400 Ultra Traditional Alkyd Semi-Gloss Enamel.

4) Moore: Satin Impervo #235.

5) PPG: 27 Line Wallhide Low Odor Interior Enamel Wall and Trim Semi-Gloss Oil.

6) P & L: S/D 5700 Series Cellu-Tone Alkyd Satin Enamel.

7) S-W: Classic 99 Interior/Exterior Semi-Gloss Alkyd Enamel A-40 Series.

B. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:

1. Semigloss, Alkyd-Enamel Finish: 2 finish coats over a primer.

d) Primer: Latex-based, interior primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mil.

1. Devoe: 50801 Wonder-Tones Interior Vinyl Latex Primer-Sealer.

2. Fuller: 220-20 Pro-Tech Interior Latex Wall Primer and Sealer.

3. Glidden: 5111 Spred Ultra Latex Primer-Sealer.

4. Moore: Regal First Coat Interior Latex Primer & Underbody #216.

5. PPG: 17-10 Quick-Dry Interior Latex Primer-Sealer.

6. P & L: Z/F 1001 Suprime "1" 100 Percent Acrylic Multi-Purpose Primer.

7. S-W: ProMar 200 Interior Latex Wall Primer B28W200.

e. First and Second Coats: Odorless, semigloss, alkyd, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.6 mil.

1) Devoe: 26XX Velour Interior Alkyd Semi-Gloss Enamel.

2) Fuller: 206-XX Interior Alkyd Semi-Gloss Enamel.

3) Glidden: UH 8400 Ultra Traditional Alkyd Semi-Gloss Enamel.

4) Moore: Moore's Alkyd Dulamel #207.

5) PPG: 27 Line Wallhide Low Odor Interior Enamel Wall and Trim Semi-Gloss Oil.

6) P & L: S/D 5700 Cellu-Tone Alkyd Satin Enamel.

7) S-W: Classic 99 Interior Alkyd Semi-Gloss Enamel A-40 Series.

C. Ferrous Metal: Provide the following finishes system over ferrous metal.

1. Full-Gloss, Alkyd-Enamel Finish: 2 finish coats over an enamel undercoater and a primer.

a. Primer: Quick-drying, rust-inhibitive, alkyd-based or epoxy-metal primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mil.

1. Devoe: 13101 Mirrolac Rust Penetrating Metal Primer.

2. Fuller: 621-04 Blox-Rust Alkyd & Structural Metal Primer.

3. Glidden: 5207 Glid-Guard Tank & Structural Primer, White.

4. Moore: IronClad Retardo Rust-Inhibitive Paint #163.

5. PPG: 6-208 Speedhide Interior/Exterior Rust Inhibitive Steel Primer.

6. P & L: S 4551 Tech-Gard High Performance Rust Inhibitor Primer.

7. S-W: Kem Kromik Metal Primer B50N2/B50W1.

b. Undercoat: Alkyd, interior enamel undercoat or full-gloss, interior, alkyd-enamel finish coat, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mil.

1. Devoe: 70XX Mirrolac Interior/Exterior Alkyd-Urethane Gloss Enamel.

2. Fuller: 220-07 Interior Alkyd Enamel Undercoat.

3. Glidden: 4500 Series Glid-Guard Alkyd Industrial Enamel.

4. Moore: Moore's Alkyd Enamel Underbody #217.

5. PPG: 6-6 Speedhide Interior Quick-Drying Enamel Undercoater.

6. P & L: S/D 1001 Suprime "11" Interior Alkyd Wood Primer.

7. S-W: Industrial Enamel B-54 Series.

c. Finish Coat: Full-gloss, alkyd, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mil.

1) Devoe: 70XX Mirrolac Interior/Exterior Alkyd-Urethane Gloss Enamel.

2) Fuller: 312-XX EPA Compliant Heavy-Duty Enamel.

3) Glidden: 4500 Series Glid-Guard Alkyd Industrial Enamel.

4) Moore: Impervo Enamel #133.

5) PPG: 54 Line Pittsburgh Paints Gloss-Oil Interior/Exterior Enamels.

6) P & L: S/D 1100 Series Effecto Enamel.

7) S-W: Industrial Enamel B-54 Series.

END OF SECTION 09900

SECTION 10155 - TOILET COMPARTMENTS

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 toilet compartments and screens as follows:

1. Type: Stainless Steel.
2. Compartment Style: Ceiling hung.
3. Screen Style: Wall hung.

B. Related Sections include the following:

1. Division 5 Section "Metal Fabrications" for supports that attach units to overhead structural system.

2. Division 10 "Toilet and Bath Accessories" for toilet paper holders, grab bars, purse shelves, and similar accessories.

1.3 SUBMITTALS

A. Product Data: For each type and style of toilet compartment and screen specified. Include details of construction relative to materials, fabrication, and installation. Include details of anchors, hardware, and fastenings.

B. Shop Drawings: For fabrication and installation of toilet compartment and screen assemblies. Include plans, elevations, sections, details, and attachments to other work.

1. Show locations of reinforcement and cutouts for compartment-mounted toilet accessories.

C. Samples for Initial Selection: Manufacturer's color charts consisting of sections of actual units showing the full range of colors, textures, and patterns available for each type of compartment or screen indicated.

1.4 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions in areas of installation by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating units without field measurements. Coordinate supports, adjacent construction, and fixture locations to ensure actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide materials that have been selected for surface flatness and smoothness. Exposed surfaces that exhibit pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections on finished units are unacceptable.

B. Stainless-Steel Sheet: ASTM A 666, Type 302 or 304, that is leveled to stretcher-leveled flatness, finished exposed faces as indicated in the "Stainless-Steel Sheet finishes" Article, and of the following minimum thicknesses:

1. Pilasters (Unbraced): 0.0500 inch (1.3 mm)
2. Panels and Screens: 0.0312 inch (0.8 mm)
3. Doors: 0.0312 inch (0.8 mm)
4. Tapping Reinforcement: 0.0781 inch (2.0 mm)

C. Core Material for Metal-Faced Units: Manufacturer's standard sound-deadening honeycomb of resin-impregnated kraft paper in thickness required to provide finished thickness of 1 inch (25 mm) minimum for doors, panels, and screens and 1-1/4 inches (32 mm) minimum for pilasters.

D. Pilaster Shoes and Sleeved (Caps): ASTM A 666, Type 302 or 304 stainless steel, not less than 0.0312 inch (0.8 mm) thick and 3 inches (75 mm) high, finished to match hardware.

E. Full-Height (Continuous) Brackets: Manufacturer's standard design for attaching panels and screens to walls and pilasters of the following material:

1. Material: Stainless steel.

F. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories of the following material:

1. Material: Stainless steel.

G. Anchorages and Fasteners: Exposed fasteners of stainless steel with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use hot-dip galvanized or other rust-resistant, protective-coated steel.

2.2 FABRICATION

A. General: Provide standard doors, panels, screens, and pilasters fabricated for compartment system. Provide units with cutouts and drilled holes to receive compartment-mounted hardware, accessories, and grab bars, as indicated.

B. Metal-Faced Toilet Compartments and Screens: Pressure laminate seamless face sheets to core material and provide continuous, interlocking molding strip or lapped and formed edges. Seal corners by welding or clips. Grind exposed welds smooth.

C. Ceiling-Hung Compartments: Provide manufacturer's standard corrosion-resistant anchoring assemblies complete with threaded rods, lock washers, and leveling adjustment nuts at pilasters for connection to structural support above finished ceiling. Provide assemblies that support

pilasters from structure without transmitting load to finished ceiling. Provide sleeves (caps) at tops of pilasters to conceal anchorage.

D. Wall-Hung Screens: Provide units in sizes indicated of same construction and finish as compartment panels.

E. Doors: 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 indicated to be handicapped accessible.

1. Hinges: Manufacturer's standard self-closing type that can be adjusted to hold door open at any angle up to 90 degrees.

2. Latch and Keeper: Manufacturer's standard surface-mounted latch unit with combination rubber-faced door strike and keeper designed for emergency access. Provide units that comply with accessibility requirements of authorities having jurisdiction at compartments indicated to be handicapped accessible.

3. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent door from hitting compartment-mounted accessories.

4. Door Bumper: Manufacturer's standard rubber-tipped bumpers at out-swinging doors or entrance screen doors.

5. Door Pull: Manufacturer's standard unit that complies with accessibility requirements of authorities having jurisdiction at out-swinging doors. Provide units on both sides of doors at compartments indicated to be handicapped accessible.

2.3 STAINLESS-STEEL SHEET FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.

1. Remove or blend tool and die marks and stretch lines into finish.

2. Grind and polish surfaces to produce uniform, directional textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

B. Finish: No. 4 bright, directional polish.

C. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

D. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid,

straight, plumb, and level. Provide clearances of not more than 1/2 inch (13 mm) between pilasters and panels and not more than 1 inch (25 mm) between panels and walls. Secure units in position with manufacturer's recommended anchoring devices.

B. Ceiling-Hung Compartments: Secure pilasters to supporting structure and level, plumb, and tighten. Hang doors and adjust so bottoms of doors are level with bottoms of pilasters when doors are in closed position.

C. Screens: Attach with anchoring devices according to manufacturer's written instructions and to suit supporting structure. Set units level and plumb and to resist lateral impact.

3.2 ADJUSTING AND CLEANING

A. Hardware Adjustment: Adjust and lubricate hardware according to manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors and swing doors in entrance screens to return to fully closed position.

B. Provide final protection and maintain conditions that ensure toilet compartments and screens are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 10155

SECTION 10200 - LOUVERS AND VENTS

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. Fixed, extruded-aluminum louvers.

2. Fixed, extruded-aluminum louver penthouses.

3. Blank-off panels for louvers.

B. Related Sections include the following:

1. Division 7 Section "Joint Sealants" for sealants installed in perimeter joints between louver frames and adjoining construction.

1.3 DEFINITIONS

A.

B. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section, unless otherwise defined in this Section or in referenced standards.

C. Standard Free Area: Free area of a louver 48 inches (1220 mm) wide by 48 inches (1220 mm) high, identical to that provided.

D. Drainable-Blade Louver: Louver designed to collect and drain water to exterior at sill by means of gutters in front edges of blades and channels in jambs and mullions.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide exterior metal louvers capable of withstanding the effects of loads and stresses from wind and normal thermal movement without evidencing permanent deformation of louver components including blades, frames, and supports; noise or metal fatigue caused by louver blade rattle or flutter; or permanent damage to fasteners and anchors.

1. Wind Load: Uniform pressure (velocity pressure) of 30 lbf/sq. ft. (1440 Pa), acting inward or outward.

2. Thermal Movements: Provide louvers that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, and other detrimental effects:

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

B. Air-Performance, Water-Penetration, and Air-Leakage Ratings: Provide louvers complying with performance requirements indicated, as demonstrated by testing manufacturer's stock units 48 inches (1220 mm) wide by 48 inches (1220 mm) high. Test units according to AMCA 500.

1. Perform testing on unpainted, cleaned, degreased units.

2. Perform water-penetration testing on louvers without screens.

1.5 SUBMITTALS

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

B. Shop Drawings: For louver units and accessories. Include plans; elevations; sections; and details showing profiles, angles, and spacing of louver blades. Show unit dimensions related to wall openings and construction; free area for each size indicated; profiles of frames at jambs, heads, and sills; and anchorage details and locations.

C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for units with factory-applied color finishes.

D. Samples for Verification: Of each type of metal finish required, prepared on Samples of same thickness and material indicated for final Work. Where finishes involve normal color and texture variations, include Sample sets showing the full range of variations expected.

E. Product Certificates: Signed by manufacturers of louvers certifying that the products furnished comply with requirements and are licensed to bear the AMCA seal based on tests made according to AMCA 500 and complying with AMCA's Certified Ratings Program.

F. 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.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain louvers and vents through one source from a single manufacturer where alike in one or more respects regarding type, design, or factory-applied color finish.

B. Welding Standards: As follows:

1. Comply with AWS D1.3, "Structural Welding Code--Sheet Steel."

2. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

C. SMACNA Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" recommendations for fabrication, construction details, and installation procedures.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify louver openings by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.2 MATERIALS

A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy 6063-T5 or T-52.

B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Aluminum Castings: ASTM B 26/B 26M, alloy 319.

D. Fasteners: Of same basic metal and alloy as fastened metal or 300 series stainless steel, unless otherwise indicated. Do not use metals that are incompatible with joined materials.

1. Use types and sizes to suit unit installation conditions.

2. Use Phillips flat-head screws for exposed fasteners, unless otherwise indicated.

E. Anchors and Inserts: Of type, size, and material required for loading and installation indicated. Use nonferrous metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as needed for corrosion resistance. Use toothed steel or expansion bolt devices for drilled-in-place anchors.

F. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12 but containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D 1187.

2.3 FABRICATION, GENERAL

A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

1. Continuous Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates and without interrupting blade-spacing pattern.

B. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining materials' tolerances, and perimeter sealant joints.

1. Frame Type: Channel type, unless otherwise indicated.

D. Include supports, anchorages, sill extensions, and accessories required for complete assembly.

E. Provide vertical mullions of type and at spacings indicated, but not more than recommended by manufacturer, or 72 inches (1830 mm) o.c., whichever is less. At horizontal joints between louver units, provide horizontal mullions, unless continuous vertical assemblies are indicated.

F. Provide sill extensions and loose sills made of same material as louvers where indicated or required for drainage to exterior and to prevent water penetrating to interior.

G. Join frame members to one another and to fixed louver blades with fillet welds, threaded fasteners, or both, as standard with louver manufacturer, concealed from view; unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.4 FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Louver Construction: Provide fixed-blade louvers with extruded-aluminum frames and blades.

1. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

B. Horizontal, Drainable-Blade Louvers: As follows:

1. Louver Depth: 4 inches (100 mm), unless otherwise indicated.

2. Frame Thickness: 0.125 inch (3.18 mm).

3. Blade Thickness: 0.125 inch (3.18 mm).

4. Blade Angle and Spacing: 45 degrees and 4 inches (100 mm) o.c. for 4-inch- (100-mm-) deep louvers.

C. Louver Penthouse: Provide fixed drainable blades.

1. Interior Reinforcement: Manufacturers standard.

2. Roof: Manufacturers standard.

3. Exterior Corners: Prefabricated corner units with mitered and welded blades aligned with straight sections, with concealed bracing.

2.5 LOUVER SCREENS

A. General: Provide each exterior louver and penthouse with louver screens complying with the following requirements:

1. Screen Location for Fixed Louvers: Interior face.

2. Screening Type: Bird screening.

B. Secure screens to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches (150 mm) from each corner and at 12 inches (300 mm) o.c.

C. Louver Screen Frames: Fabricate screen frames with mitered corners to louver sizes indicated and to comply with the following requirements:

1. Metal: Same kind and form of metal as indicated for louver to which screens are attached.

a. Reinforce extruded-aluminum screen frames at corners with clips.

2. Finish: Mill finish, unless otherwise indicated.

3. Type: Non-rewirable, U-shaped frames for permanently securing screen mesh.

D. Louver Screening for Aluminum Louvers: As follows:

1. Bird Screening: Aluminum, 1/2-inch- (12.7-mm-) square mesh, 0.063-inch (1.6-mm) wire.

2.6 BLANK-OFF PANELS

A. General: Fabricate blank-off panels from materials and to sizes indicated and comply with the following requirements:

1. Finish: Same as finish applied to louvers, but black color.

2. Attach blank-off panels to back of louver frames with clips.

B. Uninsulated, Blank-off Panels: Metal sheet complying with the following requirements:

1. Aluminum sheet for aluminum louvers, as follows:

a. Thickness: 0.050 inch (1.2 mm), unless otherwise indicated.

2. Seal perimeter joints between panel faces and louver frames with 1/8-by-l-inch (3.2-by-25-mm) PVC compression gaskets.

2.7 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish louvers after assembly.

2.8 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with system established by the Aluminum Association for designating aluminum finishes.

B. Louver, Wall:

1. Class I, Color Anodic Finish: AA-M12C22A42/A44 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural

Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 606.1 or AAMA 608.1.

a. Color: Dark bronze.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate Setting Drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.2 INSTALLATION

A. Locate and place louver units level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

3.3 ADJUSTING, CLEANING, AND PROTECTING

A. Periodically clean exposed surfaces of louvers and vents that are not protected by temporary covering to remove fingerprints and soil during construction period. Do not let soil accumulate until final cleaning.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Protect louvers and vents from damage during construction. Use temporary protective coverings where needed and approved by louver manufacturer. Remove protective covering at the time of Substantial Completion.

1. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Contracting Officer, remove damaged units and replace with new units.

END OF SECTION 10200

SECTION 10270 - ACCESS FLOORING

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 type(s) of access flooring systems:

1. Gravity-held panels on stringerless understructure.

B. Related Sections include the following:
1. Division 9 Section "Carpet " for carpet tiles applied over access flooring panels.
2. Division 16 Section "Grounding and Bonding" for connection to ground of access flooring understructure.

1.3 PERFORMANCE REQUIREMENTS

A. Performance Requirements, General: Provide access flooring systems consisting of proprietary portable assemblies composed of modular floor panels on elevated supports (understructures) forming accessible underfloor cavities (air spaces) to accommodate electrical and mechanical services and complying with performance requirements specified.

B. Structural Performance per CISCA A/F: Provide access flooring systems capable of withstanding the following loads and stresses within limits and under conditions indicated, as determined by testing manufacturer's current standard products according to referenced procedures in CISCA A/F, "Recommended Test Procedures for Access Floors":

1. Concentrated-Load Performance: Provide floor panels, including those with cutouts, capable of withstanding a concentrated design load of the following magnitude, with a bottom-surface deflection under load and a permanent set not to exceed, respectively, [0.10 and 0.010 inch (2.54 and 0.25 mm), measured below each applied-load location at horizontal surface of nearest composite beam, as determined by applying concentrated load through a 1-inch- (25.4-mm-) square or 1.128-inch- (28.6-mm-) diameter steel indentor according to CISCA A/F, Section I, "Concentrated Loads."

   a. 1000 lbf (4448 N).

2. Ultimate-Load Performance: Provide access flooring systems capable of withstanding a minimum ultimate concentrated load equal to value obtained by multiplying specified concentrated floor panel design load by a factor of 2.5, without failing, according to

CISCA A/F, Section II, "Ultimate Loading." Failure is defined as the point at which access flooring system will not take any additional load.

3. Pedestal Axial-Load Performance: Provide pedestal assemblies, without panels or other supports in place, capable of withstanding a 5000 lbf (22.24 kN) axial load per pedestal, according to CISCA A/F, Section V, "Pedestal Axial Load Test."
4. Pedestal Overturning-Moment Performance: Provide pedestal assemblies, without panels or other supports in place, capable of withstanding an overturning moment per pedestal of 1000 lbf x inches (113 N x meters), according to CISCA A/F, Section VI, "Pedestal Overturning Moment Test."

C. Floor Panel Impact-Load Performance: Provide access flooring system capable of withstanding an impact load of 125 LBF (566 n) when dropped from 36 inches (914 mm) onto a 1-sq. in. (6.5-sq. cm) area located anywhere on panel, without failing. Failure is defined as collapse of access flooring system.

1. UL Compliance: Provide flooring materials listed and labeled to comply with UL 779.

D. Panel-to-Understructure Resistance: Not more than 10 ohms.

1.4 SUBMITTALS

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

B. Shop Drawings: Include the following:

1. Complete layout of access flooring based on field-verified dimensional relationships to adjoining work and installation tolerances.
2. Details with descriptive notes indicating materials, finishes, fasteners, typical and special edge conditions, accessories, understructure, and other data to permit a full evaluation of entire access flooring system.
3. For installed access flooring indicated to comply with earthquake loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Samples for Initial Selection: For each type of floor covering and exposed finish indicated.

1. One complete full-size floor panel, pedestal, and understructure unit for each type of access flooring system required.

D. Product Certificates: For each type of access flooring system indicated, signed by product manufacturer.

E. Qualification Data: For Installer.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency or by access flooring manufacturer and witnessed by the qualified testing agency.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain access flooring through one source from a single manufacturer.

B. NFPA Standard: Provide access flooring complying with NFPA 75 requirements for raised flooring.

C. Provide floor panels that are clearly and permanently marked on their underside with panel type and concentrated-load rating.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls, columns, and other construction contiguous with access flooring by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and locations of walls, columns, and other construction and proceed with fabricating products without field measurements. Coordinate wall, column, and other construction to ensure that actual dimensions correspond to established dimensions.

1.7 COORDINATION

A. Coordinate location of mechanical and electrical work in underfloor cavity to prevent interference with access flooring pedestals.

B. Mark pedestal locations on subfloor by use of a grid, with a module equal to the width of five floor panels in both directions, to enable mechanical and electrical work to proceed without interfering with access flooring pedestals.

C. Proceed with installation only after completion of other construction within affected spaces.

1.8 EXTRA MATERIALS

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

1. Standard Field Panels: 2%.
2. Pedestals: 2%.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Floor Panels, General: Provide modular field panels complying with the following requirements that one person, using a portable lifting device, can interchange with other field

panels without disturbing adjacent panels or understructure and that are free of exposed-metal edges with floor covering in place:

1. Nominal Panel Size: 24 by 24 inches (610 Panel Size: 600 mm.
2. Fabrication Tolerances: Fabricate panels to the following tolerances with squareness tolerances expressed as the difference between diagonal measurements from corner to corner:

    a. Size and Squareness: Plus or minus 0.015 inch (0.38 mm) of required size, with a squareness tolerance of plus or minus 0.015 inch (0.38 mm), unless tolerances are otherwise indicated for a specific panel type.
    b. Flatness: Plus or minus 0.020 inch (0.50 mm), measured on a diagonal on top of panel.

3. Panel Attachment to Understructure: By gravity.

4. Basis of Design: Tate Access Floors "Concore 1000 panels – Posilock under structure system."

B. Filled Formed-Steel Panels: Fabricated with die-cut flat top sheet and die-formed and stiffened steel bottom pan formed from cold-rolled steel sheet and joined together by resistance welding. Fill panels with lightweight cementitious materials. Metal surfaces shall be protected against corrosion by manufacturer's standard factory-applied finish to produce units of the following type:

1. Nonperforated Panels: Flat solid top surface.

C. Pedestals: Assembly consisting of base, column with provisions for height adjustment, and head (cap); made of steel or aluminum or a combination of both.

1. Base: Square or circular base with not less than 16 sq. in. (103 sq. cm) of bearing area.
2. Provide vibration-proof leveling mechanism for making and holding fine adjustments in height over a range of not less than 2 inches (50 mm) and for locking at a selected height so deliberate action is required to change height setting and vibratory displacement is prevented.
3. Provide units of sufficient height to achieve underfloor clearance indicated.

4. Head: Designed for direct, nonbolted support of panels.

    a. Provide sound-deadening pads or gaskets at contact points between heads and panels.

2.2 ACCESSORIES

A. Colors and Finishes: For exposed accessories available in more than one standard color or finish, comply with the following requirements:

1. Colors, Textures, and Patterns: As selected from manufacturer's full range.

B. Cutouts: Provide cutouts in floor panels for cable penetrations and service outlets. Provide reinforcement or additional support, if needed, to make panels with cutouts comply with standard performance requirements.

1. Trim edge of cutouts with manufacturer's standard plastic molding.

2. Seal cutouts to comply with manufacturer's requirements.

C. Cavity Dividers: Provide manufacturer's standard metal dividers located where indicated to divide underfloor cavities.

D. Vertical Closures (Fasciae): Where underfloor cavity is not enclosed by abutting walls or other construction, provide manufacturer's standard metal-closure plates with factory-applied finish.

E. Ramps: Manufacturer's standard ramp construction of width and slope indicated, but not steeper than 1:12, with raised-disc rubber or vinyl floor covering, and of same materials, performance, and construction requirements as access flooring.

F. Railings: Standard extruded-aluminum railings, at ramps and open-sided perimeter of access flooring where indicated. Include handrail, intermediate rails, posts, brackets, end caps, wall returns, wall and floor flanges, plates, and anchorages where required. Provide railings that comply with structural performance requirements specified in the following Section:

1. Division 5 Section "Metal Fabrications."

G. Panel Lifting Device: Manufacturer's standard portable lifting device of type required for lifting panels with floor covering provided. Provide four lifting devices of each type required.

H. Perimeter Support: Where indicated, provide manufacturer's standard method for supporting panel edge and form transition between access flooring and adjoining floor covering at same level as access flooring.

PART 3 - EXECUTION

3.1 PREPARATION

A. Preinstallation Adhesive Field Test: Before installing pedestals, field test their adhesion to subfloor surfaces as follows:

1. In areas representative of each subfloor surface, set typical pedestal assemblies in same adhesive and methods required for completed work.
2. Allow test installation to cure for 30 days, with a pressure of 25 lbf (111 N) applied vertically to pedestals during this period.
3. After curing, apply lateral load against a straight steel bar inserted 2 inches (50 mm) into pedestal stems. Measure the force needed to cause adhesive failure of pedestal base.
4. Proceed with installation only after tests show compliance with performance requirement specified for pedestals' capability to resist overturning moment.

B. Locate each pedestal, complete any necessary subfloor preparation, and vacuum clean subfloor to remove dust, dirt, and construction debris before beginning installation.

3.2 INSTALLATION

A. Install access flooring system and accessories under supervision of access flooring manufacturer's authorized representative to produce a rigid, firm installation that complies with performance requirements and is free of vibration, rocking, rattles, and squeaks.

B. Set pedestals in adhesive as recommended by access flooring manufacturer to provide full bearing of pedestal base on subfloor.

C. Lay out floor panel installation as shown on the drawings. Scribe perimeter panels to provide a close fit with adjoining construction with no voids greater than 1/8 inch (3 mm) where panels abut vertical surfaces.

1. Connect grounding strips embedded in static-conductive floor covering to connector clips attached to pedestals at intervals needed to comply with performance requirements for electrical resistance of floor covering.

D. Secure stringers to pedestal heads according to access flooring manufacturer's written instructions.

E. Scribe underfloor-cavity dividers to closely fit against subfloor surfaces and seal with mastic to maintain plenum effect within underfloor cavity.

F. Scribe vertical closures to closely fit against subfloor and adjacent finish floor surfaces. Set in mastic and seal to maintain plenum effect within underfloor cavity.

G. Clean dust, dirt, and construction debris caused by floor installation, including vacuuming subfloor area, as installation of floor panels proceeds.

H. Cut and trim access flooring and perform other dirt-or-debris-producing operations as remotely as possible from installation area and to prevent contamination of subfloor under access flooring already installed.

I. Level installed access flooring to within 0.10 inch (2.54 mm) of true level over entire access flooring area and within 0.062 inch (1.6 mm) in any 10-foot (3-m) distance.

3.3 ADJUSTING, CLEANING, AND PROTECTION

A. After completing installation, vacuum clean access flooring and cover with continuous sheets of reinforced paper or plastic. Maintain protective covering until time of Substantial Completion.

B. Replace access flooring panels that are stained, scratched, otherwise damaged, or not complying with specified requirements.

END OF SECTION 10270

SECTION 10522 - FIRE EXTINGUISHERS, CABINETS, AND ACCESSORIES

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. Fire extinguishers.
2. Fire extinguisher cabinets.
3. Fire extinguisher mounting brackets.

1.3 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product data for cabinets include rough-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type and materials, trim style, door construction, panel style, and materials.

1.4 QUALITY ASSURANCE

A. Single-Source Responsibility: Obtain extinguishers and cabinets from one source from a single manufacturer.

B. Coordination: Verify that cabinets are sized to accommodate type and capacity of extinguishers indicated.

C. UL-Listed Products: Fire extinguishers shall be UL listed with UL listing mark for type, rating, and classification of extinguisher.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. J.L. Industries
2. Larsen's Manufacturing Co.
3. Modern Metal Products by Muckle.
4. Potter-Roemer, Inc.
5. Samson Metal Products, Inc.

2.2 FIRE EXTINGUISHERS

A. General: Provide fire extinguishers for each cabinet and other locations indicated, in colors and finishes selected by Contracting Officer's Representative from manufacturer's standard, that comply with authorities having jurisdiction.

B. Multipurpose Dry Chemical Type: UL-rated: 10#ABC, 10 lb., 2.26 Kg nominal capacity, in enameled steel container.

2.3 MOUNTING BRACKETS

A. Brackets: Designed to prevent accidentally dislodging extinguisher, of sizes required for type and capacity of extinguisher indicated, in plated finish.

1. Provide brackets for extinguishers not located in cabinets and for those located in cabinets.

2.4 CABINETS

A. Construction: Manufacturer's standard box, with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Weld joints and grind smooth. Miter and weld perimeter door frames.

B. Cabinet Type: Suitable for containing the following:

1. Fire extinguisher.

C. Cabinet Mounting: Suitable for the following mounting conditions:

1. Recessed: Cabinet box (tub) semi-recessed in walls of sufficient depth to suit style of trim indicated.

D. Trim Style: Fabricate trim in one piece with corners mitered, welded, and ground smooth.

1. Exposed Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

a. Square-edge trim with 1/4 inch backbend depth.
b. Trim Metal: Aluminum.

E. Door Material and Construction: Manufacturer's standard door construction, of material indicated, coordinated with cabinet types and trim styles selected.

1. Aluminum: Manufacturer's standard flush, hollow aluminum door construction.

2. Door Glazing: Fully tempered float glass complying with ASTM C 1048, Condition A, Type I, Quality q3, Kind FT, Class as follows:

a. Class 1 (clear).

F. Identify fire extinguisher in cabinet with FIRE EXTINGUISHER lettering applied to door. Provide lettering to comply with authorities having jurisdiction for letter style, color, size, spacing, and location.

1. Application Process: Silk screen.

G. Identify bracket-mounted extinguishers with FIRE EXTINGUISHER in red letter decals applied to wall surface. Use letter size, style, and location as selected by Contracting Officer's Representative.

H. Door Style: Manufacturer's standard design.

1. Frameless Tempered Full-Glass Panel: Frosted, tempered float glass with polished edges and inside surface etched with lettering or design indicated.

I. Door Hardware: Provide manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated. Provide either lever handle with cam-action latch, or exposed or concealed door pull and friction latch. Provide concealed or continuous-type hinge permitting door to open 180 deg.

2.5 FINISHES FOR CABINETS, GENERAL

A. Comply with NAAMM "Metal Finishes Manual" for recommendations relative to applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying temporary strippable protective covering prior to shipping.

2.6 STEEL CABINET FINISHES

A. Surface Preparation: Solvent-clean surfaces complying with SSPS-SP 1 to remove dirt, oil, grease, and other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5 (white metal blast cleaning) or SSPC-SP 8 (pickling).

B. Baked-Enamel Finish: Immediately after cleaning and pretreatment, apply manufacturer's standard two-coat baked-enamel finish consisting of prime coat and thermosetting topcoat. Comply with paint manufacturer's instructions for applying and baking.

1. Color and Gloss: Manufacturer's standard color and gloss designations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for thickness and framing for cabinets to verify cabinet depth and mounting prior to cabinet installation.

B. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Follow manufacturer's printed instructions for installation.

B. Install in locations and at mounting heights indicated or, if not indicated, at heights to comply with applicable regulations of governing authorities.

1. Prepare recesses in walls for cabinets as required by type and size of cabinet and style of trim and to comply with manufacturer's instructions.

2. Fasten mounting brackets and cabinets to structure, square and plumb.

END OF SECTION 10522

SECTION 10801 - TOILET AND BATH ACCESSORIES

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 toilet and bath accessory items as scheduled.

B. Toilet compartments and related accessories are specified in Division 10.

1.3 SUBMITTALS

A. General: Submit the following according to Conditions of Contract and Division 1 Specifications Sections.

B. Product data for each toilet accessory item specified, including construction details relative to materials, dimensions, gages, profiles, mounting method, specified options, and finishes.

C. Schedule indicating types, quantities, sizes, and installation locations (by room) for each toilet accessory item to be provided for project.

D. Maintenance instructions including replaceable parts and service recommendations.

1.4 QUALITY ASSURANCE

A. Inserts and Anchorages: Furnish accessory manufacturers' standard inserts and anchoring devices that must be set in concrete or built into masonry. Coordinate delivery with other work to avoid delay.

B. Single-Source Responsibility: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise acceptable to Contracting Officer's Representative.

1.5 PROJECT CONDITIONS

A. Coordination: Coordinate accessory locations, installation, and sequencing with other work to avoid interference with and ensure proper installation, operation, adjustment, cleaning, and servicing of toilet accessory items.

1.6 WARRANTY

A. Warranty: Submit a written warranty executed by mirror manufacturer, agreeing to replace any mirrors that develop visible silver spoilage defects within warranty period.

B. Warranty Period: 10 years from date of Substantial Completion.

C. The warranty shall not deprive the Government of other rights the Government may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide toilet accessories by one of the following:
1. A & J Washroom Accessories.
2. American Specialties, Inc.
3. Bobrick Washroom Equipment, Inc.
4. Bradley Corporation.
5. General Accessory Manufacturing Co.
6. McKinney/Parker.

2.2 MATERIALS, GENERAL

A. Stainless Steel: AISI Type 302/304, with polished No. 4 finish, 22-gage minimum thickness.

B. Brass: Leaded and unleaded, flat products, ASTM B 19; rods, shapes, forgings, and flat products with finished edges, ASTM B 16; Castings, ASTM B 30.

C. Sheet Steel: Cold-rolled, commercial quality ASTM A 366, 20-gage minimum. Surface preparation and metal pretreatment as required for applied finish.

D. Galvanized Steel Sheet: ASTM A 527, G60.

E. Chromium Plating: Nickel and chromium electro-deposited on base metal, ASTM B 456, Type SC 2.

F. Mirror Glass: Nominal 1/4 inch thick, conforming to ASTM C 1036, Type I, Class 1, Quality q2, and with silvering, electro- plated copper coating, and protective organic coating.

G. Galvanized Steel Mounting Devices: ASTM A 153, hot-dip galvanized after fabrication.

H. Fasteners: Screws, bolts, and other devices of same material as accessory unit, or of galvanized steel where concealed.

2.3 ACCESSORIES

A. Provide accessories as scheduled on the drawings.

2.4 FABRICATION

A. General: No names or labels are permitted on exposed faces of toilet and bath accessory units. On either interior surface not exposed to view or on back surface, provide identification of each accessory item either by a printed, waterproof label or a stamped nameplate indicating manufacturer's name and product model number.

B. Recessed Toilet Accessories, General: Except where otherwise indicated, fabricate units of all-welded construction, without mitered corners. Hang doors or access panels with full-length, stainless steel piano hinge. Provide anchorage that is fully concealed when unit is closed.

C. Framed Mirror Units, General: Fabricate frames for glass mirror units to accommodate wood, felt, plastic, or other glass edge protection material. Provide mirror backing and support system that will permit rigid, tamperproof glass installation and prevent moisture accumulation, as follows:

6. Provide galvanized-steel backing sheet, not less than 22 gage and full mirror size, with nonabsorptive filler material. Corrugated cardboard is not an acceptable filler material.

2.5 MIRROR UNIT HANGERS

A. Provide system for mounting mirror units that will permit rigid, tamperproof, and theftproof installation, as follows:

6. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.

2.6 KEYS

A. Provide universal keys for access to toilet accessory units requiring internal access for servicing, resupply, etc. Provide minimum of six keys to Government's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install toilet accessory units according to manufacturers' instructions, using fasteners appropriate to substrate as recommended by unit manufacturer. Install units plumb and level, firmly anchored in locations and at heights indicated.

B. Secure mirrors to walls in concealed, tamperproof manner with special hangers, toggle bolts, or screws. Set units plumb, level, and square at locations indicated, according to manufacturer's instructions for type of substrate involved.

C. Install grab bars to withstand a downward load of at least 113 Kg per 304 mm complying with ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust toilet accessories for proper operation and verify that mechanisms function smoothly. Replace damaged or defective items.

B. Clean and polish all exposed surfaces strictly according to manufacturer's recommendations after removing temporary labels and protective coatings.

END OF SECTION 10801

SECTION 12496 – WINDOW TREATMENT

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. Track and black-out curtains for all spaces scheduled.

1.3 SUBMITTALS

A. Instructions:

1. Drapery hardware.

B. Test Reports:

1. Flame resistance

C. Color Selection Samples:

1. Drapery fabric

Submit a range of three samples, 900 by 900 mm (36 by 36 inches) or larger of the manufacturers' full range of colors and patterns. Once selected, label approved samples to identify locations for their use in the project. Maintain identification and approval markings until final acceptance of the work.

D. Sample Installation:

1. Sample requirements.

Provide one full size window installation including hardware. Install the finished drapery on a stationary track.

E. Operations and Maintenance Manuals:

Submit for completed drapery system; include laundering and dry cleaning instructions for fabrics requiring special care. Furnish separate instruction sheet for each material (one for the fiberglass, one for Verel, etc.) For fabrics which are not permanently or inherently flame resistant, furnish instruction to include frequency and process required for retreating the fabric to renew the effectiveness of the flame resistant treatment. Head each sheet with name and number of room or rooms in which each material is hung. In lieu of instruction sheets, provide instructions on small,

permanent labels (either iron-on type or sewn-on) affixed to back of the heading of each panel

1.4 DELIVERY, STORAGE AND HANDLING

Deliver draperies and hardware to the site in sealed containers clearly labeled with manufacturer's name and contents. Store in a safe, dry, clean, and well ventilated area. Do not open containers until needed for installation, unless verification inspection is required.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fabrics: Provide fabric manufactured from man made for natural fibers. Fabric physical characteristics shall be the manufacturer's standard for medium duty service.

1. Drapery Lining: Soft black-out type.

2. Flame Resistance: UL 214 or NFPA 701: Drapery fabric and lining shall pass the small and large scale test. Treatment to enhance flame resistance shall be permanent type. Fabric shall pass the small and large scale test after being subjected to the accelerated dry cleaning or laundering cycles specified in UL 214 or NFPA 701.

3. Heading: Provide heading for break-a-way mounting.

B. Drapery Hardware:

1. Hand Traverse Cordless Track System: Extra heavy duty track assembly with baton on room side of draperies where it is readily visible and easily used. Ceiling mounted in extruded aluminum track anodized in bronze finish.

2. Snap-Tape System Track: Dovetail slots in clear folding linkage. Carriers shall be one piece molded plastic snap tab type to mate with snap-on components sewn to drapery heading.

3. Fasteners: Zinc or cadmium plated.

C. Fabrication: prior to cutting and fabrication, field measure each drapery location paying particular attention to field conditions affecting the work.

1. Drapery Fabrication:

a. Make from full or half widths of fabric to give a minimum of 250 percent fullness. Provide conventional pleats. Draperies shall be below sill length. Below sill length draperies shall hang 4 inch (100 mm) window sills. Cut fabric to allow for pleats and for outside ends to walls. Accurately match patterned fabrics to provide identical designs horizontally and vertically on each window within each room. Where variations in length or placement of windows occur in a room, match patterns horizontally. When fabricating panels from fabrics which require special methods or instructions, conform to the workroom instructions provided by the fabric manufacturer. Sew seams and hems using a firm interlocking stitch at a stitch rate per millimeter inch appropriate to fabric being sewn. Sew

with enough slack present so that thread shrinkage due to laundering and dry cleaning will not pucker seams and hems. Do not expose seam and hem raw edges.

b. Headings: Pleat evenly to required widths. Make headings 100 mm (4 inches) high with triple French pleats, and double fold. Include permanent finish stiffener of buckram, crinoline, or pellon across entire heading. Paper stiffening is not acceptable. Machine stitch pleats for a depth of at least 95 millimeters (3 ¾ inches). Do not use horizontal stitching across the width of the heading.

c. Seams: Join widths by serging, overlock, and safety stitch. Retain salvage when practical.

d. Hems: Double fold hems (top and bottom) and blind stitch so as not to show on the panel face. Make side seams 38 mm (1 ½ inches) wide and bottom seams 100 mm (4 inches) deep with weights sewn 13 mm (1/2 inch) above hem bottom. Provide weights at corners and each vertical seam. When lining is attached to the drapery fabric, single fold heading is acceptable, however, double fold the bottom hem.

e. Lining Fabrication:

Look stitch lining to the back of the fabric panel. Hem fabric panel and lining panel separately at the bottom.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Ensure that work of other trades and cleaning operations are completed.

3.2 INSTALLATION

Install draperies in rooms and areas scheduled on the drawings. Include all material indicated, specified or necessary for a complete finished installation. Contractor shall be responsible for the required quantities of draperies and hardware.

A. Hardware:

Install in accordance with the manufacturer's printed instructions and as specified herein. Install ceiling tracks parallel to walls and windows, fasten at each end, at 400 mm (16 inches) from each end and with additional intermediate fasteners spaced not more than 1200 mm (48 inches) apart.

Fastener	Structural Material
Case hardened, self-tapping sheet metal screw	Sheet metal

B. Draperies:

Install to provide full black-out service. Insert heading hooks at rear of each pleat, placed to obtain the clearance specified. Press well before hanging, except fiberglass. Dress down and adjust hung

draperies to provide best form and appearance. Draperies shall operate smoothly and easily over the full range of travel. Remove incorrectly sized drapery and remake to correct size. Remove damaged, spotted, or otherwise defective fabric and repair to original state or replace with new material.

END OF SECTION 12511

SECTION 12511 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes venetian blinds.

1.3 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product data for each type of horizontal louver blind specified. Include printed data on physical characteristics.

C. Shop drawings showing location and extent of blinds. Show installation details at and relationship to adjoining work. Include elevations indicating blind units. Indicate location of blind controls.

D. Samples for initial selection in the form of manufacturer's color charts showing the full range of colors, textures, and patterns available for each type of horizontal louver blind indicated.

E. Samples for verification of the following products, in manufacturer's standard sizes, showing the full range of color, texture, and pattern variations expected. Prepare samples from the same material to be used for the Work.

F. Schedule of horizontal louver blinds.

G. Maintenance data for horizontal louver blinds to include in the operation and maintenance manual specified in Division 1. Include the following:

1. Methods for maintaining horizontal louver blinds and finishes.

2. Precautions for cleaning materials and methods that could be detrimental to finishes and performance.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide horizontal louver blinds identical to those tested for the following fire-test-response characteristics as determined by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Test Method: NFPA 701.
2. Rating: Pass.

B. Single-Source Responsibility: Obtain each type of horizontal louver blind from one source and by a single manufacturer.

1.5 PROJECT CONDITIONS

A. Field Measurements: Check actual horizontal louver blind dimensions by accurate field measurements before fabrication, and show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

B. Space Enclosure and Environmental Limitations: Do not install horizontal louver blinds until space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings is complete, and ambient temperature and humidity conditions are and will be continuously maintained at values near those indicated for final occupancy.

1.6 EXTRA MATERIALS

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

1. Horizontal Louver Blinds: Before installation begins, furnish uantity of full-size units equal to 5 percent of amount of each size installed.

PART 2 - PRODUCTS

2.1 HORIZONTAL LOUVER BLINDS

A. Louvers: Manufacturer's standard as follows:

1. Aluminum.

B. Tilt Operation: Manual with wand.

1. Length of Tilt Control: Full length of blind.
2. Position of Tilt Control: Left side, unless otherwise indicated.
3. Position of Cord Lock: Right side, unless otherwise indicated.

C. Cord Equalizers: Self-aligning to maintain horizontal louver blind position.

D. Colors and Patterns: Where manufacturer's standard products are indicated, provide horizontal louvers complying with the following requirements:

1. Provide C.O.R.'s selections from manufacturer's full range of colors and patterns for horizontal louver blinds of type indicated.

2.2 FABRICATION

A. Product Standard and Description: Comply with AWCMA Document 1029 for each horizontal louver blind unit consisting of louvers, rails, cord locks, tilting mechanisms, tapes, and installation hardware.

B. Lifting and Tilting Mechanisms: Noncorrosive, self-lubricating materials.

C. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):

1. Blind Units Installed Outside Jambs: Width and length as indicated, with terminations between blinds of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

D. Installation Fasteners: Not less than 2 fasteners per bracket, fabricated from metal noncorrosive to blind hardware and adjoining construction; support blind units under conditions of normal use.

E. Hold-Down Brackets: Manufacturer's standard, as indicated.

F. Side Channels: Manufacturer's standard, as indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of horizontal louver blinds. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install blinds level, plumb, and located so exterior louver edges in any position are not closer than 1 inch (25 mm) to interior face of glass lites.

1. Head Mounted: Install headrail on face of opening head.

3.3 ADJUSTING

A. Adjust components and accessories for proper operation.

3.4 CLEANING

A. Clean blind surfaces, according to manufacturer's instructions, after installation.

B. Remove surplus materials, packaging, rubbish, and debris resulting from installation. Leave installation areas neat, clean, and ready for use.

3.5 PROTECTION

A. Provide final protection and maintain conditions in a manner acceptable to manufacturer and Installer that ensure that horizontal louver blinds are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 12511

SECTION 13330 - WET-PIPE SPRINKLER SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Scope: Provide a complete wet-pipe automatic sprinkler system, and associated equipment, ready for operation.

B. Description of Work: The work includes the design and installation of a new and modifying an existing wet-pipe automatic sprinkler system to afford complete fire protection throughout the building.

C. Existing Sprinkler Equipment: Existing sprinkler equipment shall be maintained fully operational until the new system has been accepted by the authority having jurisdiction and the Government.

D. Equipment Removal: After acceptance of the new system by the AHJ and Government, all existing equipment so indicated shall be removed and properly disposed of and all damaged surfaces shall be restored as herein specified.

E. Compliance: The entire wet-pipe automatic sprinkler system shall be designed in accordance with section 1.3 A. Any reference to "authority having jurisdiction" shall be interpreted to mean the NIMA Regional Safety and Environment Branch. All material and equipment used shall be listed or approved by UL, FM or another nationally recognized testing agency approved by the Contracting Officer, for their intended use and service.

F. Related Sections and Divisions:

1. Refer to these Division-15 specifications for related guidance:

   a. Supports and Anchors
   b. Mechanical Identification
   c. Mechanical Basic Requirements

2. Refer to these Division-16 specifications for related guidance:

   a. Fire Alarm and Detection Systems

3. Refer to this Division-7 specification for related guidance:

   a. Firestopping

1.2 QUALITY ASSURANCE

A. Installer Requirements: Design shall be by a NICET Level III or IV Technician or a Registered Fire Protection Engineer. Installation shall be performed by a certified sprinkler contractor or a specialist who is experienced in the design and installation of automatic sprinkler systems (minimum 3 years). Design and installation must be performed by a sprinkler contractor whose business is located within a 75 miles(120

kilometers)radius of the Capitol and whose business has been operated and established within this radius for at least three (3) years.

The Contractor shall submit the following for verification of qualifications:

Prior to installation, submit documentation, to the Contracting Officer, showing that the Contractor has successfully installed automatic fire suppression sprinkler systems of comparable size, type and design as specified herein or that the Contractor has a firm contractual agreement with a Subcontractor having such experience. The data shall include the names and locations of at least two installations where the Contractor, or Subcontractor, installed such systems. The Contractor, or Subcontractor, shall certify that each system has performed satisfactorily for a period of not less than one year.

B. Project Superintendent: The Contractor, or Subcontractor, shall provide one full-time, on-site staff member designated as the "Project Superintendent". The duties of the Project Superintendent are to supervise execution of all aspects of this specification, including safety on the job site as described in the "Accident Prevention Clause" of the general provisions of the Occupational Safety and Health (OSH) Act of 1970. That clause incorporates into the contract, by reference, the Secretary of Labor's OSH Standards (29 CFR Part 1926). The Project Superintendent shall be thoroughly familiar with all contract obligations and shall be capable of making all contractual decisions with regards to their project scope of work on behalf of the Contractor, or Subcontractor. The Project Superintendent shall be responsible for making sure that quality control review has been performed on all submittals prior to the submission to the Contracting Officer. The Project Superintendent shall also be responsible for ensuring that all submittals are accurate and fully coordinated.

C. Service Organization: The Contractor shall furnish, to the Contracting Officer, evidence that there is an experienced and effective service organization which carries a stock of repair parts for the system in order to readily effect repairs throughout the warranty period. Should the Contractor fail to comply with the service requirements of this section, the Government will then have the option to make the necessary repairs and back charge the Contractor without any loss of warranty or guarantee as provided by the contract documents.

D. Guarantee: The Contractor shall guarantee labor, materials, and equipment provided under this contract against defects for a period of one year after the date of final acceptance of this work by the Government. Final Acceptance includes, but is not limited to, the receipt of as-built drawings and operation and maintenance manuals.

E. Codes and Standards: Provide a wet-pipe sprinkler system conforming to the latest editions of codes and standards of the following organizations:

1. National Fire Protection Association (NFPA), including all amendments and appendices:

   No. 13 Standard for the Installation of Sprinkler Systems.

   No. 1963 Standard for Screw Threads and Gaskets for Fire Hose Connections.

   No. 25 Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.

2. American Water Works Association (AWWA)
   AWWA C651 (Addendum 1990) Disinfecting Water Mains)

3. Factory Mutual Engineering and Research Corporation (FM)
   FM-P7825 Approval Guide

4. Underwriters Laboratories Inc. (U.L.)
   UL-FPED Fire Protection Equipment Directory

5. Building Officials and Code Administrators (BOCA) National Building Code.

6. Other NIMA approved testing laboratory or applicable ANSI/ASTM standards.

1.3 SYSTEM DESIGN

A. General: Design automatic sprinkler systems in accordance with all required and advisory provisions of NFPA 13, except where modified herein, by hydraulic calculations for ordinary hazard occupancy with uniform water distribution over the design area. Each system shall include materials, accessories, and equipment, so that the system is complete and ready for use. Design and provide each system to give full consideration to blind spaces, piping, electrical equipment, ducts and other construction and equipment in accordance with detailed working drawings to be submitted for approval.

1. Location of Sprinkler Heads: The spacing of sprinkler heads shall not exceed that permitted by NFPA 13 for ordinary hazard occupancy. Where practical, uniformly space sprinklers on the branch piping. Locate sprinkler heads in a pattern consistent with ceiling grid, lights, and air supply diffusers. In all areas with suspended acoustical tile ceilings sprinklers shall be located in the center of the ceiling tile.

2. Water Distribution: Distribution shall be uniform throughout the area in which the heads will operate. Discharge from individual heads in the hydraulically most remote area shall be at least 100 percent of the specified density.

3. Density of Application of Water: Application to horizontal surfaces below the sprinklers shall be 0.12gpm/ft(4.9mm/min). Pipe shall be sized to provide the specified density when the system is discharging the total maximum required flow.

4. Sprinkler Discharge Area: The discharge area shall be the hydraulically most remote 3000 square feet (279 square meters) area as defined in NFPA 13.

5. Total Combined Inside & Outside Hose Allowances: Hydraulic calculations shall include an allowance of 250gpm (945Lpm) for hose streams, added at the point of connection to the water supply.

6. Friction Loss: Calculate the friction loss in piping in accordance with the Hazen-Williams formula using 'C' values found in NFPA 13.

7. Water Supply: Base hydraulic calculations on a static pressure of 102psi with 1040gpm available at a residual pressure of 78psi. Flow hydrant at elevation 172

feet. Gauge hydrant at elevation 181.5 feet. Test date 4/2/03. Test location: Fremont Building, driveway.

1.4 SUBMITTALS

A. Conform to the requirements of Division-1, Section "SUBMITTALS." Submit 6 complete sets of submittals. Partial submittals will not be acceptable and will be returned without review. Before any work is commenced, the submittal must be approved by the AHJ and the NIMA Regional Safety and Environment Branch. Manufacturer's data shall be provided for the following and annotated to show the specific model, type and size of each item:

1. Check valves
2. Sprinkler heads, cabinet, escutcheons and guards
3. Pressure and waterflow switches
4. Inspector's test valves
5. Drain valves
6. Valves including gate and globe
7. Pipe, fittings, hangers, supports, and mechanical couplings
8. Tamper switches
9. All wiring
10. Pressure gages
11. All other associated equipment

B. Test Certification and Instruction: Submit test certification, to the Contracting Officer, for all pipe and fittings.

C. Shop Drawings: Submit detailed shop drawings, in accordance with NFPA 13, "Working Plans", on uniform size sheets no smaller than 30x42”(760x1070mm), to the AHJ and the Contracting Officer for review and approval. Information shall include but not be limited to the following:

1. Layout indicating details, plan view, elevations and sections of the system piping. Indicate the location of sprinkler heads and piping in relation to the ceiling layout, showing pipe lengths and sizes.

2. Detailed riser diagram showing schematic of systems supply, supply connection, devices, valves, pipe and fittings.

3. Point-to-point electrical wiring diagrams for all alarm and supervisory devices.

4. The signature and seal of a registered Professional Fire Protection Engineer, registered Professional Engineer with a minimum of two years fire protection design experience, or a NICET Level III or IV Technician.

5. Hydraulic calculations in accordance with the following:

a. Minimum operating pressure of any sprinkler shall be according to NFPA 13 and appropriate listing or FM approval.

b. Pipe friction loss may be calculated by using the nearest foot (0.3 meters) for all piping over 1.0 foot(0.3 meters) in length. Horizontal lengths less

than 1.0 foot(0.3 meters) may be neglected. Vertical length less than 1.0 foot(0.3 meters) shall be included for elevation purposes only.

c. Flows shall be calculated to the nearest whole gallon or liter.

d. Velocity pressures may be neglected.

e. Velocities in all piping shall not exceed 20 feet (6.1 meters) per second. Velocities in standpipes must be calculated based on the combined sprinkler and hose flow.

f. Submit name of hydraulic program used, if applicable.

6. Current waterflow test information.

1.5 AS-BUILT DRAWINGS

A. General: Prepare and submit to the Contracting Officer 6 sets of detailed "As-Built Drawings". The drawings shall show the system as installed, including all deviations from both the project drawings and the approved shop drawings. The drawings shall also include all information as required by NFPA 13. The drawings shall be prepared on uniform sized sheets not less than 30x42”(760x1070mm). Submit these drawings within two weeks after the final acceptance test of the system.

B. The Contractor is to provide an isometric diagram of all new and existing standpipe/sprinkler system riser piping showing all control valve locations.

1.6 OPERATION AND MAINTENANCE MANUALS

A. General: Not less than 7 calendar days prior to the final acceptance testing of the entire system, and for use during the instruction period hereinafter specified, provide 6 bound copies of an Operation and Maintenance Manual to the Contracting Officer. The manual shall include an index, copies of all approved shop drawings and submittal materials (updated to as-built conditions), and a complete parts list of all components. The manual shall also include, for each item, the manufacturer's name, the serial number of the part, an ordering number, if appropriate, and a physical description of the part. The manual shall include all data relative to all valves, water flow and tamper switches.

PART 2 - PRODUCTS

2.1 ABOVEGROUND PIPING SYSTEMS

A. General: Provide piping, valves, and fittings, approved for 175psi (12.1Bar) working pressure, in accordance with NFPA 13, as indicated on the drawings and as specified herein. Conceal piping in areas with suspended ceilings as indicated on the contract drawings. Provide fittings for changes in direction of piping and for connections. Make changes in pipe size through tapered reducing pipe fittings; bushings will not be permitted. Steel piping with wall thickness less than Schedule 40 shall not be threaded. Plastic piping shall not be permitted. Minimum pipe schedule shall be schedule 40. Side outlet tees using rubber gasketed fittings shall not be permitted. All sprinkler piping shall be so installed that it can be thoroughly drained, and, where practical, shall be arranged to drain at the main riser drain.

B. Fittings: Fittings, mechanical couplings and rubber gaskets shall be supplied by the same manufacturer. Fittings into which sprinkler heads, sprinkler head riser nipples, or drop nipples are threaded shall be welded, threaded, or grooved-end type. Plain-end fittings will not be permitted.

C. Control Valves: Provide valves in accordance with NFPA 13 and as follows:

1. Riser and sectional control valves shall be O.S.& Y. type.

A. O.S.& Y. Type: Shall be iron body and brass mounted and open by counterclockwise rotation. Each interior control valve shall be provided with adequate means for mounting a tamper switch.

2. Drainage and test valves shall be all bronze globe, angle or gate valves.

3. Provide gate valves in piping to sprinklers protecting elevator machine rooms, elevator hoistways, computer rooms and transformer vaults. Valves shall be located outside the room in an accessible location. Provide tamper switches on all such valves.

4. All control valves shall be labeled so as to indicate the area/zone that is serviced by that valve.

D. Check Valves:

1. All check valves shall be clear opening swing-check types.

a. 2 inch (50 mm) and smaller check valves shall be all bronze with screw ends.

b. 2-1/2 inches (64 mm) and larger check valves shall be either iron body, brass mounted with flanged ends, access plate, and non-ferrous metal set rings and bearings or groove-lock type.

E. Pipe and Hanger Supports: Provide pipe supports, sway braces, hangers, and clamps in accordance with NFPA 13.

F. Identification Signs: Attach properly lettered and approved metal signs to each control valve, alarm device, inspector's test valve, drain valve, and alarm bypass valve. Each sign shall indicate the normal valve position as well as the portion of the system that the valve serves. Permanently affix hydraulic design data nameplates to the control valve of each system.

G. Drain Assemblies: Provide all drain lines as required by NFPA 13. Connect all drain piping to approved drain locations and provide splashguards, where necessary, at discharge outlets.

1. The main drain valve shall discharge outside the building or to sight cones attached to drains of adequate size to readily receive the full flow from each drain under maximum pressure.

2. All drain discharge outlets on the outside of the building shall be located no higher than 1.0 foot (0.3 meters) above grade level.

3. Drains provided as part of floor control valves shall discharge to an express drain located adjacent to the sprinkler riser. Drains shall be of the combination inspector's test/drain type.

2.2 SPRINKLER HEADS

A. General: Sprinkler heads shall be in conformance with NFPA 13.

B. Types: Release elements shall be suitable for specific application. Provide quick response heads in all areas in which their use is listed or approved. Extended coverage upright and pendant sprinkler heads shall not be permitted. Heads located within the air streams of unit heaters or other heat emitting equipment or skylights shall be selected for proper temperature rating.

C. Corrosion and Mechanical Protection: Provide corrosion-resistant sprinkler heads where they are exposed to weather, moisture or corrosive vapors. Protect heads installed where they might receive mechanical injury or are less than 7 feet(2.1 meters) above the floor level with approved guards in accordance with NFPA 13.

D. Suspended Ceilings: Provide pendant sprinklers, with pipe and fittings located above the suspended ceiling. Provide polished stainless steel plates, chromium-plated finish on copper alloy ceiling plates, or escutcheons and chromium-plated sprinklers below suspended ceilings.

E. Spare Sprinkler Heads: Provide one metal cabinet containing a stock of spare sprinkler heads of all types and ratings installed as well as any special tools required for removal or replacement of the heads. The number of spare sprinklers shall conform to NFPA 13. The cabinet shall be located, in an area where the temperature will not exceed 100°F.(38°C), and approved by the Contracting Officer.

2.3 WATERFLOW SWITCHES

A. Vane-Type Switches: Provide vane-type waterflow switches where indicated on the drawings. The device shall contain double pole, double throw contacts and screw terminals for each conductor. Devices shall also be equipped with a time delay feature which is field adjustable from zero to at least 90 seconds. The time delay shall be initially set to 30 seconds. Connection to the fire alarm system shall be as specified in Section 16721.

2.4 SUPERVISORY (TAMPER) SWITCH

A. General: Provide a tamper switch for each interior sprinkler system control valve, as well as outside post indicating valves. Tamper switches shall have double pole, double throw contacts with screw terminals for each conductor. Operation of the switch shall cause a supervisory signal to be transmitted to the FACP upon not more than two complete turns of the valve wheel or a closure of twenty percent, whichever is less. Connection of this device to the fire alarm system shall be as specified in Section 16721.

2.5 ESCUTCHEON PLATES

A. General: Provide escutcheons for pipes passing through walls, partitions, or suspended-type ceiling. Escutcheons shall be steel, primed and finish painted to match adjacent wall finish.

2.6 PIPE SLEEVES

A. General: Provide pipe sleeves where piping passes entirely through walls, floors and partitions. Secure sleeves in position during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, floors and roofs. Provide 1 inch (25 mm) minimum clearance between exterior of piping and interior of sleeve or core-drilled hole. Firmly pack space with mineral wool insulation. Seal space at both ends of the sleeve or core-drilled hole with plastic waterproof cement which will dry to a firm but pliable mass, or provide a mechanically adjustable segmented elastomeric material. Penetrations of fire-rated wall and floor assemblies shall be sealed with a listed firestopping material as described in Specification 07270.

1. Sleeves in Masonry and Concrete Walls, Floors, and Roofs: Provide hot-dip galvanized steel, ductile-iron, or cast-iron sleeves. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in the core-drilled hole are completely grouted smooth.

2. Sleeves in Other Than Masonry and Concrete Walls, Floors, and Roofs: Provide 26 gauge galvanized steel sheet.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation, workmanship, fabrication, assembly, erection, examination, inspection and testing shall be in accordance with NFPA 13, except as modified herein. Install piping straight and true to bear evenly on hangers and supports. Do not hang piping from plaster ceilings. Keep the interior and ends of new piping and existing piping affected by Contractor's operation thoroughly cleaned of water and foreign matter. Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter. Inspect piping before placing into position.

B. Field Changes: Do not make field changes in the piping layout or pipe sizes without the prior approval of the Contracting Officer.

C. Freeze Protection: Protect wet-pipe sprinkler piping subject to temperatures lower than 40 degrees F(4.5 degrees C) against freezing in accordance with NFPA 13.

D. Welding: Perform all welding in the shop; field welding must be approved by the NIMA Regional Safety and Environment Branch. All welding activities must be approved by the Contracting Officer before they occur.

E. Painting: Painting shall meet the requirements of the Painting and Finishing specification. In addition, exposed threads of all ferrous pipe shall be given one coat of

corrosion-resistant paint at the time of installation. All piping and other metal that is exposed in unfinished areas, except sprinkler heads, bronze, chrome or brass fittings, and moving parts shall be painted red. Risers and other piping in stairwells shall be painted red. Concealed piping shall have 4 feet(100 mm) wide red painted bands placed no more than 10 feet(3 meters) on center and on each side of wall penetrations.

3.2 FIRESTOPPING

A. General: Firestop all holes for conduit, piping, or other penetrations which pass through floor slabs, fire-rated walls, partitions with fire-rated doors, vertical service shafts, or any fire-rated assemblies in accordance with Section 07270, Firestopping.

3.3 TESTING

A. Preliminary Testing: Hydrostatically test wet-pipe sprinkler system, as required by NFPA 13 and underground piping in accordance with NFPA 24, in the presence of the Contracting Officer or his designated representative. The Contractor and an authorized representative from each supplier of equipment shall be in attendance at the preliminary test. Test waterflow alarms, tamper switches, and all other devices for smooth and correct operation. Test the waterflow alarms by flowing water through the inspector's test connection. When tests are completed and corrections made, submit a signed and dated material and test certificate similar to that specified in NFPA 13, with a request for formal inspection and tests. A member of the NIMA fire alarm shop must be present at the preliminary test.

B. Final Inspection and Testing: Advise the Contracting Officer when hydrostatic and alarm tests have been completed and all necessary corrections made, so as to permit final inspection and testing. Submit request for testing at least 15 calendar days prior to test date. A final acceptance test <u>will not be scheduled</u> until operation and maintenance manuals have been received by the Contracting Officer.

1. At the final test, a material and test certificate must be provided in accordance with NFPA 13.

2. Submit up-to-date red-lined shop drawings to the Contracting Officer at the final test. These drawings shall be undamaged sets of prints of the shop drawings, with changes from the original drawings marked in red.

3. The final test shall be witnessed by a representative of the Regional NIMA Safety and Environment Branch, the NIMA Fire Alarm Shop, and the NIMA Inspection Team, Fee Developer Division. The Contractor and an authorized representative from each supplier of equipment shall be in attendance at the final test.

4. Final testing shall include, but is not limited to, full flow testing through both the main drain and the inspector's test connection as well as testing of all waterflow and tamper switches.

5. Provide all equipment, services and labor to properly perform all required tests. The Regional NIMA Safety and Environment Branch shall supervise all testing.

END OF SECTION 13330

SECTION 15010 - MECHANICAL BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general mechanical requirements for work specified in all other sections of Division 15, the drawings, and schedules and by the requirements of this Section.

B. Division 1: Refer to Division 1 sections for general requirements.

1.2 QUALITY ASSURANCE

A. Labels and Listings: Refer to Division 1 for requirements that materials, appliances and equipment provided meet the requirements of the Underwriter's Laboratories, Inc. (UL) and other standards organizations. Lettering size and style shall comply with American National Standards Institute, Inc. (ANSI) A13.1 "Scheme for the Identification of Piping Systems."

B. National Fire Protection Association (NFPA): All work provided under this Contract shall meet the requirements of the NFPA.

C. Current Models: All work shall be as follows.

1. Manufactured items furnished shall be the current, cataloged product of the manufacturer.

2. Replacement parts shall be available.

D. Experience: Unless more stringent requirements are specified in other sections of Division 15, manufactured items shall have been installed and used, without modification, renovation or repair, on other projects for not less than one year prior to the date of bidding for this project.

E. Experience List: Submit a list of installations where the following items have been in operation for not less than one year. Include project name, address, name and telephone number of the Owner's representative for each project.

F. Compliance with State and Local Codes:

1. Government Owned Property: Compliance with Federal, State, and local regulations and codes for the prevention, control, and abatement of air and water pollution is mandatory.

2. Government Leased Property: Compliance with State and local codes is required.

1.3 SUBMITTALS

A. Division 1: Conform to the requirements of Division 1, Section 01003, "Submittals."

B. Submittal List: Items for which submittals are required are included in each section of Division 15.

C. Submit "Coordination Drawings" per the requirements of para. 1.10 "Coordination" of this Section.

D. Approval is Required: No submittal item shall be fabricated, delivered to the site, or installed, etc. until its submittal has been approved.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Refer to Section 01600, for the requirements of material and products to be delivered to the project site.

B. Storage: Materials stored at the project site which becomes soiled with construction dirt, concrete or earthwork shall be washed, cleaned and dried to the satisfaction of the Contracting Officer's representative or removed from the project site and replaced with new. Do not install soiled material.

C. Protection: Protect and store material and equipment in such a manner as to effectively prevent damage from climatic conditions.

1.5 LABELS AND NAMEPLATES

A. Conform to Division 01 requirements for all work furnished under this Division.

B. Manufacturer's Nameplates: Nameplates on manufactured items shall be aluminum or Type 304 stainless steel sheet, not less than 20 USG (1 mm) riveted or bolted to the manufactured item, with nameplate data engraved or punched to form a non-erasable record of equipment data.

C. Field Installation: Field-installed nameplates shall be engraved melamine plastic laminate, 1/8-inch (3 mm) thick, engraved in block capital lettering to expose white lettering on black face. Screw or bolt to equipment. Adhesive attachment will not be permitted.

D. Smaller Labels: Labels 20 square inches (13000 $mm^{2)}$ and less may be 1/16-inch (1.5 mm) thick. Secure labels with rivets, stainless steel bolts, stainless steel strap or supporting angle.

E. Approval: Submit a schedule of nameplates, abbreviations and equipment designations for approval.

F. Lettering Style: Comply with ANSI A13.1 for lettering size and style.

1.6 MAINTENANCE AND OPERATING MANUALS

A. Conform to the requirements of Division 01 for all manuals and operating information required under Division 15.

B. Field Installed Schedules: Conform to the requirements of Division 01 for all diagrams, charts, schedules and operating information required under Division 15.

C. Instructions: Conform to the requirements of Division 01 for all work furnished under Division 15. Examine each section of Division 15 for instruction, training and operating manual requirements.

D. Manuals for Commissioning Tests: Operating manuals shall include those for commissioning instrumentation where submittals are required. Operating manuals shall also include test procedures for commissioning tests.

E. For the mechanical Operation and Maintenance manuals for a project, generally there shall be (a) one manual (in multiple copies) for the automatic temperature control (ATC), prepared by the ATC specialist subcontractor, and (b) one manual (in multiple copies) for all the other mechanical equipment.

F. The ATC Manual shall include all the ATC equipment catalog cuts for the project.

1.7 SUBSTITUTIONS

A. Conform to the requirements of Division 01.

1.8 RENOVATION PROJECTS

A. Demolition: Provide disconnection, demolition and renovation work specified under Division 15 and as indicated and scheduled on the drawings.

B. Damage: Where pipe, ductwork, insulation or equipment to remain is inadvertently damaged or disturbed, cut out and remove damaged section and provide new pipe, ductwork, insulation or equipment of equal capacity and quality.

C. Accessible Work: Exposed pipe and ductwork to be demolished shall be removed in its entirety.

D. Abandoned Work: Buried pipe abandoned in place, shall be cut out approximately 2 inches (50 mm) beyond the face of adjacent construction, capped, and the adjacent surface patched to match existing finish.

E. Removal: Equipment specified or indicated to be demolished, shall be removed from the project site and shall not be reused.

F. Temporary Disconnection: Equipment required to be temporarily disconnected and relocated shall be carefully removed, stored, cleaned, reinstalled, reconnected and made operational.

G. All dimensions, clearances, pipe and duct routings, etc., shall be confirmed at the site before any fabrication, equipment ordering, or installation is done.

1.9 SIZING

A. Capacity: Provide equipment and material of sizes, capacities, power input, power ratings and dimensions indicated on the drawings, in the schedules and as specified.

B. Fit and Clearance: All equipment, such as chillers, pumps, boilers, air-handling equipment, and filters, shall fit the space shown on the project drawings. Provide access for servicing, repairing and inspecting apparatus at least equal to that shown. Each item of equipment shall be installed without damage to the building, building equipment, or the item itself.

Verify building access constraints before delivery of equipment to the project site.

C. Deviations: Equipment and material of greater or larger power, dimensions, capacity and ratings may be furnished, provided such proposed equipment is approved in writing and feeders, circuit breakers, conduit, motors, bases and equipment spaces are increased by the contractor at no cost to the Government. If minimum energy ratings or efficiencies of the equipment are specified, the equipment must meet the design requirements and shall be subjected to the requirements of commissioning tests specified in article "Quality Assurance," of this Section.

1.10 COORDINATION

A. General: Coordinate mechanical work with that of other trades in order to:

1. Avoid interference between general construction, mechanical, electrical, structural and other specialty trades.

2. Maintain clearances and advise other trades of clearance requirements for operation, repair, removal and testing of mechanical equipment.

3. Coordination Drawings drawn to a scale of not less than 1/4-inch to one foot shall be submitted for above ceiling installation of Ductwork, cable trays, communication systems, sprinklers, pipes, valves, lighting fixtures and specialties showing coordination of work between the different trades and with the structural and architectural elements of work. Drawings shall be in sufficient detail to show overall dimensions of related items, clearances, and relative locations of work in allotted spaces. Drawings shall indicate where conflicts or clearance problems exist between various trades prior to the furnishing and installation of the work on site.

1.11 POSTED OPERATING INSTRUCTIONS

A. General: Furnish approved operating instructions for systems and equipment indicated in the technical sections for use by operation personnel. The operating instructions shall include wiring diagrams, control diagrams, and control sequence for each principal system and equipment. Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. Attach or post operating instructions adjacent to each principal system and equipment including start-up, operating, shutdown, safety precautions and procedure in the event of equipment failure. Provide weather-resistant materials or weatherproof enclosures for operating instructions exposed to the weather. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal.

1.12 MANUFACTURER'S RECOMMENDATIONS

A. General: Where installation procedures or any part thereof are required to be in accordance with manufacturer's recommendations, furnish printed copies of the recommendations prior to installation. Installation of the item shall not proceed until recommendations are received. Failure to furnish recommendations shall be cause for rejection of the equipment or material.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (Not Used)

2.2 DIVISION 15 SECTIONS

A. General: Conform to the requirements of Division 15 sections for all products furnished under this Contract.

2.3 CATWALKS, STAIRS AND LADDERS

A. General: Provide catwalks and ladders where Required.

1. Construct ladders of structural steel channel side frames with 30-inch by 9-inch (800 mm by 120 mm) treads of 1-inch (25 mm) thick industrial galvanized grating and provide handrails of 1-1/2-inch (40 mm) Schedule 40 pipe welded and ground or screwed into malleable iron railing fittings.

2. Construct catwalks as detailed on the drawings, not less than 30-inch (800 mm) width with 1-inch (25 mm) industrial grating walkways and 42-inch (1070 mm) high handrails, with intermediate rails, constructed of 1-1/2-inch (40 mm) Schedule 40 pipe welded and ground or screwed into malleable iron railing fittings.

2.4 SUPPLIES

A. General: The Contractor shall inspect Contract Drawings for equipment requiring initial supply (i.e. emergency generators, fuel oil tanks) and provide one full supply of each prior to the completion of construction.

2.5 TEST EQUIPMENT AND TOOLS

A. The following tools and test equipment shall be turned over to the Government Representative, in the quantities noted. Obtain approval of items from Government Representative before delivery. Usual shop drawing procedure is not necessary however. All instruments shall be calibrated. Other such equipment to be provided may be separately specified in individual sections, such as "Meters and Gauges" and "Automatic Control Systems." Provide each specific item in a timely manner for it to be useful in project inspection.

1. Tools: Provide any specialized small hand tools needed for normal adjustment, maintenance, or repair of the equipment provided under Division 15 of this contract, such as air diffuser adjusting keys, screw drivers or wrenches of specialized configuration, and the like. This shall include but not be limited to the following:

a. Air diffuser adjusting keys. Quantity -- 3.

b. Air bleed keys for hydronic equipment. Quantity 3.

c. Thermostat adjusting screwdrivers. Quantity 3.

2. Water and steam pressure gauges: Provide pressure gauges meeting specifications in Section 15130 "Meters and Gauges," with .25 inch (6 mm) NPT bottom connection

and assorted adapters up to .75 inch (19 mm) size, and range 0-200 psi (0-1380 kPa.) Quantity 2.

PART 3 - EXECUTION

3.1 OUTSIDE SERVICES

A. Connection Points: Underground and overhead utility services shall be provided to utility and service line connection points.

B. Contract Limits: Where "limits of contract" designations are indicated on site plans, they shall not apply to utility service underground or overhead work necessary to serve the project and occurring outside of the "limits of contract" designations.

3.2 PAINTING AND FINISHING

A. Division 9: Refer to Section 09900, "Painting" for field painting requirements.

B. Damage and Touch-Up: Repair all marred or damaged factory painted finishes with materials and procedures to match original factory finish.

C. Identification: Provide schedules for stenciling and identification markings. Submit stenciling and identification marking for approval.

3.3 CUTTING AND PATCHING

A. Cutting: Provide cutting, channeling, chasing and drilling of floors, walls, partitions, ceilings and other surfaces necessary for installation of mechanical work. All cutting shall be performed by skilled mechanics of the trades involved.

B. Patching: Repair cut surfaces to match adjacent surfaces.

3.4 FIRESTOPPING

A. Firestopping: Unused slots, sleeves, and other penetrations in floors, walls or other general construction shall be closed and sealed with an approved firestopping material.

1. Firestopping material shall be UL listed and tested silicone elastomer specifically formulated for use in horizontal and vertical applications. The material shall possess intumescent characteristics; upon exposure to heat above 250 degrees F.(120°C) shall expand to not less than five times its original volume to form a fireproof envelope UL rated for 2-hour and 3-hour protection, when applied in accordance with the manufacturer's recommendation.

2. Floor slots and openings shall be closed with 16 gauge1.5 mm galvanized steel sheet supported on 1-inch by 1-inch by 1/8-inch (25 mm by 25 mm by 3 mm) structural angle drilled or supported with powder-driven studs into the building structure. Firestop with a layer of silicone elastomer not less than 1-inch (25 mm) thick which completely fills the opening. The top surface of the silicone elastomer shall be approximately 1-inch (25 mm) below the finished floor slab.

3. Openings in walls shall be closed with 16 gauge (1.5 mm) galvanized steel sheet securely attached at the midpoint of the wall thickness and firestopped on both sides of the steel sheet with not less than 1/8-inch (3 mm) thick layer of non-sagging silicone elastomer to fully cover the opening.

4. Single or multiple pipes passing through walls and floors shall have the annular space between pipes or between pipes and structure filled with silicone elastomer to provide a 3-hour rated firestop for floors and walls. If pipes are insulated, identical insulation may be used to pack the annular space between pipes and opening, for support of firestopping elastomer.

B. Pipe and Ducts: The annulus between exposed pipe and ductwork and walls or floors in finished spaces shall be filled, sealed, and painted to match adjacent surfaces.

C. Future Slots: Identify unused sleeves and slots for future use by permanently anchored brass nameplates identifying size and purpose of the covered slot.

3.5 FILE BOX

A. Install at the site, at a designated location, a rectangular metal box. Place in the box two copies of the plans and specifications and maintenance manuals of the project. The box shall be of appropriate size. The plans may be reduced in size by half if necessary.

END OF SECTION 15010

SECTION 15130 - METERS AND GAUGES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Thermometers and thermometer wells.
2. Pressure gauges.
3. Air flow-measuring systems.

1.2 REFERENCES

A. American National Standards Institute, Inc. (ANSI):

1. B40.1 Pressure Gauge, Indicating Dial Type, Elastic Element.

2. Z236.1 Liquid-In Glass Thermometers - General-Purpose Laboratory Use.

B. American Society of Mechanical Engineers (ASME):

C. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

D. Instrument Society of America (ISA):

1. RP31.1 Specification, Installation, and Calibration of Turbine Flowmeters, Recommended Practice.

E. Underwriters Laboratories, Inc. (UL):

1. 393 Pressure Indicating Gauge for Fire Protection Service.
2. 404 Pressure Indicating Gauge for Compressed Gas Service.

1.3 SUBMITTALS

A. Division 1: Conform to the requirements of Division 1, Section 01003, "Submittals."

B. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of meter and gauge. Submit meter and gauge schedule showing manufacturer's figure number, scale range, location, and accessories for each meter and gauge.

C. Maintenance Data: Submit maintenance data and spare parts lists for each type of meter and gauge.

D. Calibration Data: Submit calibration data for the following meters and gauges:

1. Thermometers to be used for commissioning of other equipment and for providing input for energy calculations.

2. Pressure gauges to be used for commissioning of other equipment.

1.4 QUALITY ASSURANCE

A. Codes and Standards: Design and manufacture meters and gauges in accordance with ANSI and UL standards.

B. Certification: Meters and gauges shall be calibrated by the manufacturers or by laboratories regularly engaged in calibrating these instruments. Provide calibration data and certified statement of accuracy's under specified operating conditions.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Handle meters and gauges carefully to prevent damage and breakage. Do not install-damaged meters or gauges; replace with new.

B. Storage: Store meters and gauges in original factory cartons in a clean, dry place. Protect from dirt, construction debris, and physical damage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (Not Used)

2.2 THERMOMETERS AND THERMOMETER WELLS

A. General: Provide liquid-in-glass type thermometers unless bimetal dial type is required due to space limitations or other specific conditions.

B. Scale and Dial: Provide liquid-in-glass thermometers of the organic liquid type having a nominal scale length of not less than 7 inches. (175 mm). Provide bimetal dial thermometers with a nominal 5-inch (125 mm) dial size graduated through a minimum arc of 270 degrees. (4.70 rad). Provide a recessed dial so that graduated portion and pointer are in the same plane.

C. Range: Temperature range shall be as shown on the drawings or as specified. Chilled water system 20 degrees F. to 120 degrees F.(-7degreesC to 50degreesC). Hot water system 30 degrees F. to 240 degrees F.(0degreesC to 115degreesC). Condenser water system 20 degrees F. to 120 degrees F.(-7 degrees C to 50 degrees C).

D. Case: Provide liquid-in-glass type thermometer with an aluminum alloy or steel case. Provide bimetal dial thermometers with all exposed metal parts, including the case and stem made of 300 Series stainless steel, all welded construction.

E. Accuracy and Calibration: Bimetal dial thermometers shall have zero adjustment for recalibration and shall have an accuracy of plus or minus one percent of span through the complete range. Liquid-in-glass thermometers used for indicating shall have an accuracy of plus or minus 0.5 degree F. ($\pm$0.25Cdegrees). Unless otherwise required in other sections of the specifications, thermometers for commissioning tests shall have an accuracy of plus or minus 0.25 degree ($\pm$0.15C degrees).

F. Thermometers measuring temperature for energy calculations shall have an accuracy of plus or minus 0.1 degree F.($\pm$0.05 degrees C).

G. Thermometer Wells: Provide pipe line liquid-in-glass thermometers with a union connection, tapered bulb chamber and matching taper on well. Provide bimetal dial thermometers with a

well to match bulb chamber. Provide wells for insulated pipe of the extension neck type suitable for insulation thickness. Provide wells fabricated of bronze, brass or 316 stainless steel suitable for the fluid or gas in the pipe.

H. Stem: Provide stems with a minimum length of 2-1/2 inches (65 mm) immersion which shall be increased in length as necessary to reach the center lines of the pipes in which they are installed.

I. Adjustment: Provide straight or angle pattern adjustable type thermometers as required to facilitate readings.

2.3 PRESSURE GAUGES

A. General: Provide pressure gauges, which comply with ANSI B40.1.

B. Dials: Provide dials not less than 4-1/2 inches (115 mm) in diameter, except that packaged equipment may be provided with manufacturer's standard gauges of equal accuracy.

C. Ranges: Select operating ranges so that during normal service the gauge pointer will be at the approximate midpoint of the gauge scale.

D. Refrigerant Gauges: Provide refrigerant pressure gauges with corresponding temperature scales for the particular refrigerant sensed.

E. Accuracy: Pressure gauges used for commissioning of other equipment shall have a minimum accuracy of 3 percent of span.

2.4 AIR FLOW MEASURING SYSTEMS

A. General: Provide airflow measuring systems as shown on drawings.

B. Certification: Provide air flow measuring systems certified for an accuracy of 3 percent of actual flow as determined in an approved laboratory by using calibrated orifice, calibrated nozzles, or other recognized standard procedure. Provide certification based on tests of normal production stock items. Demonstrate compliance with requirements herein, under the conditions of installation prescribed in the manufacturer's published literature. Submit testing and reporting procedures for review prior to acceptance of ratings certified. Use test apparatus with simultaneous evaluation of several sizes of Type 1 and 2 air measuring systems under an approved range of velocities. Use apparatus arrangement with self-verification of performance (example, one unit checked against another unit, as well as the recognized flow standard). Perform tests in an approved laboratory and by an approved authority in the field. Testing and approval of test reports shall conform with Section 01003, "Submittals."

C. Section Includes: Provide air-measuring systems of the following types.

1. Provide Type 1, consisting of a permanently installed flow measuring station plus readout facilities to measure the total flow in cfm (L/S) of the air handling system fan, and elsewhere in duct system where there is inadequate approach and discharge lengths of duct to permit use of Type 2 systems. Provide flow measuring station with such air straightening and equalizing devices and static pressure sensors as are required to permit measurements of actual flow with a certified accuracy of 3 percent where maximum turbulence is to be expected.

2. Provide Type 2, consisting of a permanently installed flow measuring station plus readout facilities to measure the flow in cfm (L/s) in sub-mains and branch ducts where adequate approach and discharge lengths of duct permit use of pressure integrator having modified (reduced) air equalizing devices with a certified accuracy of 3 percent.

3. Provide Type 3, consisting of a complete set of portable velocity measuring sections, gathering cones, and readout devices suitable for measuring the flow in cfm (L/s) of all air terminals.

D. Labels: Provide all flow measuring stations with permanently affixed labels containing the following information.

1. The manufacturers catalog designation (type and size).

2. The range of capacity (based on velocities from 800 fpm to 4000 fpm.(4 m/s to 20 m/s).

3. The measuring system number (Types 1 and 2 only).

4. The design capacity at point of installation (Types 1 and 2 only).

5. The area measured, square feetmetre (Types 1 and 2 only).

6. The instructions: Installation, Types 1 and 2; Operating Type 3.

7. The direction of air flow.

E. Submittals: Provide submittals in addition to regular requirements.

1. List all Type 1 and 2 measuring systems and include the following for each system:

1) The system number.

2) The zone number.

3) The system capacity.

4) The location of flow measuring station.

5) The thickness of connecting duct external insulation.

6) The thickness of connecting duct internal insulation.

7) The readout device - type and location.

2. Provide submittals including the following data for Type 3 measuring systems.

1) The capacity range of each flow measuring station to be furnished, with aggregate range suitable to accommodate the capacities of all terminals on project.

2) The listing of cone sizes to be furnished, keyed to applicable terminals, suitable

for the full range of terminal configurations and capacities on the project.

F. Casings: Provide casings of flow measuring stations for Type 1 and 2 systems constructed of galvanized sheet metal except where other metals are specified for the particular system; provide gauges of metal thickness at least equal to that specified for ducts. Provide ends of casings with stiffeners which can be mated to companion angles of connecting ductwork. Provide casings of flow measuring stations for Type 3 system made of sheet metal and stiffened in such a manner as to assure preservation of the geometry of the unit and its cross-sectioned area. Provide cones constructed so as not to damage building surfaces when measuring terminal capacities. Provide all surfaces of cones contacting terminals or other surfaces with gaskets to eliminate air leakage. Provide adapters for cones used to measure terminals attached to exposed ducts. Provide casings to enclose and protect the following components.

1. The air flow straighteners and equalizers, except for Type 3 systems.

2. The multi-point pressure sensing system to measure static pressure and total pressure. Provide pressure sensing system that senses pressures simultaneously across the flow section; number and location of sensing points to be not less than one per 36 square inch (20,000 $mm^{2)}$ of measured area as set forth in "ASHRAE Handbook of Fundamentals" for pitot tube traverse. Provide collecting tubes for sensing systems external to casing if desired.

G. Pressure Drop: Provide Types 1 and 2 flow measuring station with pressure drop not to exceed 0.6 and 0.3, respectively, times the velocity head measured at the designated area. For example, if a 12 inch by 12 inch (1000 mm by 1000 mm) Type 1 station handles a flow of 2000 cfm, (10000L/s), the average velocity is 2000 fpm (10 m/s) and the velocity head is 0.25 inch water gauge,(59 Pa), therefore, the pressure drop shall not exceed 0.15 inch water gauge. (35 Pa.) Provide Type 3 flow measuring sections with negligible pressure drop to the degree that no detectable reduction in terminal air flow shall occur as a result of applying the measuring system.

H. Air Measuring System Readout Devices: Provide air measuring system readout devices factory calibrated. Provide stationary readout devices for all Type 1 and 2 measuring systems. Provide readout device for Type 3 measuring systems incorporated, and factory- calibrated, with its velocity measuring section. Provide portable readout devices for Type 2 measuring systems consisting of a metal carrying case, leveling facilities, differential pressure gauge calibrated in inches water gauge, "On-Off" switch to permit calibration and to protect instruments, and tubing with fittings for attachment to flow measuring stations.

I. Central Readout Panel: Provide central readout panel to measure the flow at a number of flow measuring stations which are within the same room. Provide the central readout device with a single differential pressure gauge mounted in a metal cabinet with pressure manifold, labeled dual push-button for each monitored flow measuring station, "On-Off" switch to gauge, velocity pressure/cfm (pressure / L/s) conversion data plate, and mounting facilities. Provide readout devices serving Type 1 air measuring systems at the apparatus control panel of the system served.

J. Calibration: Provide the scales of differential pressure gauges of readout devices monitoring a single flow measuring station calibrated in cfm and fpm (L/s and m/s) (velocity). Provide scales of Type 3 readout devices calibrated in cfm (L/s). Provide scales of central readout devices serving multiple flow measuring stations portable readout devices calibrated in both

inches water gauge and fpm; (Pa and m/s); also, provide velocity pressure/cfm (pressure/L/s) conversion data.

K. Accessories: Provide a complete set of Type 3 air measuring systems with unused cones.

PART 3 - EXECUTION

3.1 INSTALLATION OF THERMOMETERS AND THERMOMETER WELLS

A. General: Install thermometers and thermometer wells at locations shown on the drawings and where specified. Install thermometers so that they can be read by a person standing on the floor and with normal illumination.

B. Locations: Install thermometers and thermometer wells at the following locations, and elsewhere as indicated.

1. At the inlet and the outlet of each hydronic zone.

2. At the inlet and the outlet of each hydronic coil in air handling units, and built-up central systems.

C. Thermometer Wells: Drill and tap pipes 5-inch (125 mm) and larger for installation of wells. Provide tees or reinforced welding fittings on pipes smaller than 5-inch (125 mm) for installation of wells. Provide oversize tees or enlarge pipe smaller than 3-inch (75 mm) at points where wells are installed to avoid restriction of flow.

D. Where thermometers are installed in wells, fill wells with an approved Heat Conductive Compound.

3.2 INSTALLATION OF PRESSURE GAUGES

A. General: Install pressure gauges at locations shown on the drawing and where specified.

B. Locations: Install pressure gauges in the following locations, and elsewhere as indicated.

1. At the discharge of each pressure reducing valve.
2. At the water service outlet.

C. Pressure Gauge Cocks: Provide stem mounted pressure gauges with T-handle cocks. Provide siphon for steam pressure gauges.

3.3 INSTALLATION OF AIR FLOW MEASURING SYSTEMS

A. General: Install airflow measuring systems in strict accordance with manufacturer's specifications at locations shown on the drawings and where specified.

B. Readout Panel: Install readout devices for Type 1 air measuring systems permanently at the apparatus control panel of the system served.

C. Pressure Integrators: Install the interior surface of the duct lined up with the interior of the station to provide a connection without offset, where pressure integrators are installed in lined duct systems.

END OF SECTION 15130

SECTION 15140 - SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Extent of support and anchor work required by this Section is indicated on the drawings, by requirements of this Section, and Section 15010, "Mechanical Basic Requirements."

B. Types: Types of supports and anchors specified in this Section include the following:

1. Piping Hangers and Supports
2. Piping Anchors
3. Pipe Guides

C. Related Sections: Refer to other sections of Division 15 for the following:

1. Vibration Isolation
2. Wet-Pipe Sprinkler System
3. Plumbing Piping Systems and Plumbing Specialties
4. Hydronic Piping Systems
5. Steam and Condensate Piping and Specialties
6. Sheet Metal Ductwork

D. Other Divisions: Refer to other divisions of the specification for the following work:

1. Painting: Division 9.

1.2 QUALITY ASSURANCE

A. Codes: Provide supports and anchors conforming to the following.

1. American National Standards Institute, Inc. (ANSI): Design piping system to limit the stress in the pipe to the values in ANSI including:

   a. B31.1 Power Piping

2. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS): Manufacture and install pipe supports and anchors in accordance with MSS including:

   a. SP 58 Pipe Hangers and Supports - Materials, Design and Manufacture

   b. SP 69 Pipe Hangers and Supports - Selection and Application

1.3 SUBMITTALS

A. Division 1: Conform to the requirements of Division 1, Section 01003, "Submittals."

B. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of pipe support, pipe hanger, pipe anchor, and pipe guide.

C. Shop Drawings: Submit shop drawing for the following items.

1. Fabricated expansion loops indicating location, dimensions, pipe sizes, and location and method of attachment of anchors and guides.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (Not Used)

2.2 PIPE HANGERS AND SUPPORTS: GENERAL

A. General: Provide pipe hangers and supports manufactured in accordance with MSS SP 58.

B. Clamps: Provide clamps conforming to MSS SP 58, Type 8 unless other types are approved.

2.3 HANGERS

A. General: Provide single or multiple hangers as appropriate. Provide hangers with adjustable means for controlling the level or slope of pipes. Provide turnbuckles conforming to MSS SP 58, Type 13 or 15 with a minimum of 1-1/2 inches (40 mm) of adjustment and incorporating locknuts. When turnbuckles are not provided, provide rods threaded to provide not less than 1-1/2 inches (40 mm) of adjustment. Provide rods threaded for their entire length if desired.

B. Single Hangers: Provide single pipe and duct hangers of either Types 1, 3, 4, 6, 7 and 11, MSS SP 58, where piping is supported from overhead concrete construction unless otherwise specified or approved. Provide hanger Types 3 and 4 with turnbuckles and eye rod or rods with MSS SP 58, Type 17 eye nuts.

1. Provide single rod hanger with a diameter not less than required by MSS SP 58.

2. Provide single pipe hanger brackets for pipes not larger than 5- inch125 mm that run along walls and near floors, of either Type 34, MSS SP 58 or fabricated utilizing a short angle section. Provide single hanger brackets for pipes larger than 5 inches125 mm that run along walls and near floors Types 31, 32 and 33, MSS SP 58 unless otherwise approved.

C. Trapeze Hangers: Provide trapeze hangers of either of the following types.

1. Fabricated hangers shall be constructed of a horizontal member made of an angle or channel supported from a hanger rod near each end. Individual pipes shall be attached to the horizontal member using a Type 24 U-bolt, MSS SP 58.

2. Commercially available hangers shall be galvanized and shall incorporate specifically cold formed, lipped channels, not less than 1-1/2 by 1-1/2 inch No. 12 gauge, (40 x 40 mm x 2.5 mm), designed to accept special spring held, hardened steel nuts for securing hanger rods or other attachments. Electroplated coating shall be treated with chromic acid, immediately after coating in such a manner that the coating will withstand standard spray salt on the cabinet for an average time of 120 hours, without a forming of a white deposit on the surface. Two or more such channels may be welded together to form horizontal members of greater strength than single channels.

D. Vibration Isolation: Provide supports, hangers, clamps and guide with isolation means incorporated where required for vibration isolation.

E. Anchors and Attachments: Provide fasteners attached to concrete ceilings that are vibration and shock resistant. Provide hangers for piping and ducts attached to concrete construction with one of the following types.

1. Concrete insert per MSS SP 58, Type 18.

2. Powder driven fasteners subject to approval. Each fastener shall be capable of holding a test load of 1000 pounds whereas (450 kg) where as the actual load shall not exceed 50 pounds (22 kg).

3. Self-drilling expansion shields. The load applied shall not exceed one-fourth the proof test load required.

4. Machine bolt expansion anchor. The load applied shall not exceed one-fourth the proof test load required.

2.4 ANCHORS

A. General: Provide anchors suitable for the location of installation and designed to withstand all forces and movements acting in the anchor. Manufacture pipe anchors in accordance with MSS SP 58. Provide a safety factor of four for the anchor installation.

2.5 PIPE GUIDES

A. General: Provide pipe alignment guides where indicated on the drawings or where required for proper installation of expansion loops and expansion joints. Do not consider pipe support as guides; however guides may be considered as pipe supports.

B. Radial Type Guides: Provide primary and intermediate guides of the radial type employing a heavy wall guide cylinder with weld down or bolt down anchor base and with one of the following designs:

1. A two-section guide spider, having 1/8-inch maximum diametrical clearance with guide cylinder inside diameter, bolted or welded tight to the carrier pipe which slides through the guide cylinder I.D. Cylinder shall be of sufficient size to clear pipe insulation and long enough to prevent over travel of spider. With this type, any carrier pipe insulation shall be installed flush with both sides of the guide cylinder to permit unrestricted axial travel of the spider through the inside diameter of the guide cylinder.

2. The inside diameter of the guide cylinder shall be fitted with two partially recessed low friction inserts having 1/8-inch (3 mm) maximum diametrical clearance with the carrier type O.D. With this type, the low friction inserts guide the carrier pipe. Any carrier pipe insulation can be installed flush with both ends of the guide cylinder and at O.D. of the guide cylinder. Fabricated steel plate spiders shall not be less than 4 inches (100 mm) in length. Cast semi-steel spiders shall have lengths not less than those shown in the following table:

Pipe Size-inches	Spider Length-inches
1-1/4-inch and smaller	1-inch

1-1/2-inch to 5-inch	2-inch
6-inch and Larger	3-inch

Size	Spider Length
32 mm and Smaller	25 mm
40 to 125 mm	50 mm
150 mm and Larger	75 mm

C. Spider Type Guide Cylinder: Provide the guide cylinder used with the spider type guide with a length not less than the calculated pipe expansion as determined under "Expansion Joints" plus the spider length.

D. Low Friction Radial Guide Cylinder: Provide the length of the guide cylinder of radial guides with low friction inserts independent of the expansion joint traverse; however, provide guide cylinders for this design not less than those shown in the following tables.

Pipe Size Inches	Guide Cylinder Length Inches
6-inch and smaller	6-inch
8-inch and Larger	8-inch

Pipe Size	Guide Cylinder Length
150 mm and Smaller	150 mm
200 mm and Larger	200 mm

E. Bearing Surfaces: Provide bearing surfaces of spider or low friction inserts actually in contact with either the guide cylinder I.D. or carrier pipe O.D. during pipe movement with adequate area and properly shaped to provide easy movement of pipe and to prevent binding.

F. Intermediate Pipe Guides: Provide intermediate pipe guides only of the low friction type using either 1/2-inch (13 mm) thick graphite or 3/32-inch (2.5 mm) thick reinforce TFE for the low friction material.

1. This type should be used in horizontal pipe only and shall consist of an upper assembly field welded to the carrier pipe and a lower assembly welded or bolted to the supporting structure.

2. The upper assembly shall be of sufficient height to clear insulation.

3. For sizes 2-1/2-inch (65 mm) and smaller, the upper assembly may consist of an inverted "T" bar; for 3-inch (75 mm) size and larger, the upper assembly shall be designed with a longitudinal gusset welded between two contoured cradle type gussets all welded to a backing plate.

4. The lower assembly of all sizes shall consist of a base plate fitted with two 1/2-inch (13 mm) thick minimum hold down bars having minimum length as shown in table below.

Size	Length of Hold Down Guide Bars

5-inch and Smaller	3-inch
6-inch and Larger	4-inch
125 mm and Smaller	75 mm
150 mm and Larger	100 mm

5. The low friction graphite or reinforced TFE is bonded directly to the bottom of the backing plate of the upper assembly and to the top of the base plate of the lower assembly. Where reinforced TFE is used, the TFE may be bonded to a thin gauge stainless steel plate which in turn is factory welded to the upper backing plate and lower base plate.

6. Upper Assembly Backing Plate: Provide the upper assembly backing plate of low friction intermediate guides with a length not less than the length of pipe expansion determined as specified under "Expansion Joints" plus the width of the lower assembly.

PART 3 - EXECUTION

3.1 PIPE HANGER AND SUPPORT INSTALLATION

A. General: Install water pipes, where practical, at same elevation and hang on multiple hangers. Do not install conduit on hangers with any other service. Install conduit above all other service pipes. Install the different service pipes, valves, fittings, and similar items such that after the covering is applied there will be not less than 1/2-inch15 mm clear space between the finished covering and other work and between the finished covering of parallel adjacent pipes. Install hangers for different service lines running close to and parallel with each other, in line with each other, and parallel to the lines of the building. Coordinate exact location of electric outlets, piping, ducts, and the like to avoid interferences between lighting fixtures, piping, duct, and similar items.

B. Vertical Pipes: Support vertical runs of pipe as shown on drawing and as follows.

1. Support vertical runs of pipe not over 15 feet (5 m) long with hangers placed not over one foot (300 mm) from the elbow on the connecting horizontal runs.

2. Support vertical runs of pipe over 15 feet (5 m) long but not over 60 feet (18 m) long and not over 6 inches (150 mm) in size, or not over 30 feet (9 m) long and not over 12 inches (300 mm) in size on heavy steel clamps. Bolt clamps tightly around the pipes and rest clamps securely on the building structure without blocking. Weld clamps to the pipes or place clamps below couplings.

3. Support vertical pipes longer or larger than those included in the forgoing paragraphs on base elbows or base tees resting directly on the building structure or on substantial pipe stands extending to the building structure.

C. Hanger Spacing: Space hangers for piping so as to prevent sag and permit proper drainage. Space single hangers for straight runs of standard weight steel pipe and copper tube not to exceed spans listed in Table 1. Space hangers for other piping materials in accordance with MSS SP 69. Install multiple trapeze hangers spaced not to exceed 10 feet. 3 m Install a hanger within one foot (300 mm) of each horizontal elbow.

TABLE 1
MAXIMUM HORIZONTAL PIPE HANGER AND SUPPORT SPACING

NOMINAL SIZE PIPE (INCH)	MAX. SPAN (FEET)	NOMINAL SIZE TUBING (INCH)	MAX. SPAN (FEET)
1/2 TO 1-1/4	7	1/4 TO 3/4	5
1-1/2	9	1	6
2 TO 4	10	1-1/4	7

NOMINAL SIZE PIPE	MAX. SPAN	NOMINAL SIZE TUBING	MAX. SPAN
15 to 32 mm	2000 mm	8 to 20 mm	1500 mm
40 mm	2500 mm	25 mm	1800 mm
50 to 100 mm	3000 mm	32 mm	2000 mm

D. Anchors and Attachment: Install anchors and fasteners in accordance with manufacturer's recommendations and the following.

1. In the event a self-drilling expansion shield or machine bolt expansion shield is considered to have been installed improperly, the Contractor shall make an acceptable replacement or demonstrate the stability of the anchor by performing an on-site test under which the anchor will be subjected to a load equal to twice the actual load.

2. Powder-driven fasteners may be used only where they will be concealed after the construction is complete. Where an occasional fastener appears to be improperly installed, additional fastener(s) shall be driven nearby (not closer than 6 inches (150 mm) in undisturbed concrete. Where it is considered that many fasteners are improperly installed, the Contractor shall test load any 50 successively driven fasteners. If 10 percent or more of these fasteners fail, the Contractor shall utilize other fastening means as approved and at no additional cost to the Government.

3. Hangers for piping and ducts shall be attached to cellular steel floor decks with steel plates and bolted rod conforming to the steel deck manufacturer's requirements. Where the individual hanger load exceeds the capacity of a single floor deck attachment, steel angles, beams or channels shall be provided to span the number of floor deck attachments required.
4. Welding may be used for securing hangers to steel structural members. Welded attachments shall be designed so that the fiber stress at any point of the weld or attachment will not exceed the fiber stress in the hanger rod.

E. Hangers Supported By Two Rods: Install hangers supported by two rods where required to mount pipes in minimum space because of limited headroom.

3.2 ANCHOR INSTALLATION

A. General: Anchor piping securely where shown on drawing or where required for a proper

installation and to force the pipe expansion in the proper direction. Install anchors in accordance with MSS SP 69.

B. Vertical Pipes: Anchor vertical pipes by means of clamps welded around pipes and secured to wall or floor construction.

C. Expansion Joints: Install sliding anchors to absorb thrust due to internal pressure wherever corrugated bellows expansion joints of the slotted hinge type are installed.

3.3 PIPE GUIDE INSTALLATION

A. General: Install pipe guides where indicated on the drawings and the following instances.

1. Use of guides with expansion loops shall be limited to points indicated on drawings or where required to prevent buckling of pipe, whether indicated or not.

2. Use of primary or secondary guides with expansion joints shall be controlled by recommendations of manufacturer of expansion joint as indicated in manufacturer's published literature and shall be installed in strict accordance therewith.

3.4 EXPANSION LOOPS

A. General: Provide expansion loops or offsets where indicated on the drawings or where required to relieve excessive stress in piping systems.

B. Construction: Construct loops and offsets with long-turn factory-made welded fittings and sized to limit the stress in any part of the loop or piping system to the values in the ANSI B31.1.

1. Size expansion loops without cold spring.

2. Provide four pipe guides, two on each side of each loop, and anchor to the building construction.

END OF SECTION 15140

SECTION 15170 - MOTORS

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Extent of motor work required by this Section is indicated on the drawings and schedules, by the requirements of this Section, and Section 15010, "Mechanical Basic Requirements."

B. Types: Types of motors specified in this Section include:

1. Single Phase Motors
2. Polyphase Motors - Single Speed

C. Related Sections: Refer to Division 16 sections for:

1. Circuit and Motor Disconnects
2. Motor Starters
3. Motor Control Centers
4. Motor Starter Panelboards

1.2 QUALITY ASSURANCE

A. Codes and Standards: Conform to the requirements of National Electrical Manufacturers Association (NEMA)) MG 1 "Motors and Generators."

1.3 SUBMITTALS

A. Division 1: Refer to Section 01003, "Submittals," for basic information relating to submittal requirements.

B. Product Data: Submit manufacturer's standard technical product data indicating conformance to the stipulated reference specifications, construction material, construction details, and test procedures.

1.4 DELIVERY, STORAGE AND HANDLING

A. Delivery: Handle motors carefully to prevent damage, denting and scoring. Do not install-damaged motors or components; replace with new.

B. Storage: Store motors and components in a clean, dry place. Protect from weather, dirt, water, construction debris, and physical damage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (Not Used)

2.2 MOTORS

A. General: Provide motors conforming to NEMA MG 1 and as follows.

1. Each motor shall have sufficient capacity to start and operate the machine it drives without exceeding the motor nameplate rating at the speed specified or at any speed and load which may be obtained by the drive actually furnished.

2. Each motor provided with automatic control shall be capable of making as frequent starts as the control device may demand. Motors not provided with automatic control shall be capable of making not less than 4 starts per hour.

3. All belt-connected motors, regardless of size, shall be equipped with shafts and bearings that will withstand both the normal belt pull of the drive furnished and the momentary or continuous overloads due to acceleration of incorrect belt tension.

4. Motors shall be rated for continuous duty at 100 percent of rated capacity, and temperature rise shall be based on an ambient temperature of 100°F (40 degrees Celsius).

5. 0.5 HP (0.4 kW) and larger motors generally shall be polyphase motors. Motors smaller than 0.5 HP (0.4 kW) generally shall be single-phase motors.

6. Polyphase motors shall be squirrel cages, induction in accordance with NEMA MG 1. Polyphase motors shall be wound according to the electrical data on the schedules.

7. Unless otherwise specified, single-phase motors shall be of the open, capacitor-start type, and shall be in accordance with NEMA MG 1. Single-phase motors shall be wound according to the electrical data on the schedules. In lieu of capacitor-start type, 125 W and smaller motors may be of the split-phase type or other types as specified.

PART 3 - EXECUTION

3.1 INSTALLATION OF MOTORS

A. General: Install motors where indicated on the drawings and in accordance with manufacturer's drawings and in accordance with manufacturer's published installation instructions.

B. Alignment: Install each direct-connected motor such that it is securely mounted in accurate alignment. The drive must be free from both angular and parallel misalignment when both motor and driven machine are operating at normal temperatures. Provide each belt-connected motor with a securely mounted adjustable base to permit installation and adjustment of belts.

END OF SECTION 15170

SECTION 15171 - ADJUSTABLE SPEED DRIVES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Adjustable speed drives (ASD).

1.2 RELATED SECTIONS

A. Section 16010 "Electrical Basic Requirements."

1.3 REFERENCES

A. NEMA ICS 3.1 - Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive System.

B. NEMA - Enclosures for Electrical Equipment (1000 Volts Maximum).

C. UL and CUL Approved.

D. IEEE Standard 444 (ANSI - C343).

E. IEC: 146A.

1.4 SUBMITTALS

A. Submit under provisions of Section 01003 “SUBMITTALS”.

B. Shop drawings shall include: wiring diagrams, front and side views of enclosures, overall dimensions, conduit entrance locations and requirements, nameplate legends and enclosure details.

C. Product Data: Provide data sheets showing: voltage, ratings and size of switching and over-current protective devices, short circuit ratings, and weights.

D. Manufacturers' Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of adjustable speed drive.

1.5 QUALITY ASSURANCE

A. ASD shall have a minimum MTBF (mean times between failure) rating of 100,000 hours.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 1.

B. Include instructions for starting and operating ASD, and describe operating limits that may result in hazardous or unsafe conditions.

1.7 QUALIFICATIONS

A. Manufacturer must have a minimum of ten (10) years-documented experience, specializing in adjustable speed drives.

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to site, under provisions of Division 1.

B. Accept ASD on site in original packing. Inspect for damage.

C. Store in a clean, dry space. Maintain factory wrapping, or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

D. Handle carefully, in accordance with manufacturers' written instructions, to avoid damage to components, enclosure and finish.

1.9 WARRANTY

A. Provide ASD warranty, for one year from date of startup. Warranty shall include parts and labor.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. ASD shall be manufactured by MagneTek or ABB.

2.2 DESCRIPTION

A. Provide enclosed adjustable speed drives suitable for operating at the current, voltage, and horsepower indicated on the schedule. Conform to requirements of NEMA ICS 3.1.

2.3 RATINGS

A. ASD must operate without fault or failure, when voltage varies plus or minus 10 percent from rating, and frequency varies plus or minus 5 percent from rating.

B. Displacement Power Factor: 0.98 over entire range of operating speed and load.

C. Operating Ambient Temperature: -10 degrees C to 40 degrees C (14 degrees F to 104 degrees F).

D. Humidity: Non-condensing to 90%.

E. Altitude: To 3300 feet, higher be derating.

F. Minimum Efficiency: 96% at half speed; 98% at full speed.

G. Starting Torque: 100% starting torque shall be available from 0.5 Hz to 60 Hz.

H. Overload Capability: 120% of rated F.L.A. (full load amps) for 60 seconds; 180% of rated F.L.A., instantaneously.

I. The ASD must meet the requirements for Radio Frequency Interference (RFI) above 7 MHz as specified by FCC regulations, part 15, subpart J, Class A devices.

J. In compliance with IEEE 519, the Total Harmonic Distortion (THD) for the ASD shall be no greater than 5%. When the THD is above 5%, the supplier of the ASD shall provide a dc bus choke or line reactors to ensure compliance.

2.4 DESIGN

A. ASD shall employ microprocessor based inverter logic, isolated from all power circuits.

B. ASD shall include surface mount technology, with conformal coating.

C. ASD shall employ a PWM (pulse width modulated) inverter system consisting of:

1. Input Section:

a. ASD input power stage shall convert three-phase AC line power into a fixed DC voltage via a sold state full wave diode rectifier, with MOV (metal oxide varistor) protection.

2. Intermediate Section:

a. DC bus a supply to the ASD Output Section shall maintain a fixed voltage with filtering and short circuit protection.

b. DC Bus shall be interfaced with the ASD diagnostic logic circuit, for continuous monitoring and protection of the power components.

c. Above 30 hp, the DC bus section shall include a DC bus reactor to minimize reflected harmonics. If DC bus reactor is not included, an input line reactor must be included and enclosed in the ASD enclosure.

3. Output Section:

a. Insulated gate bipolar transistor (IGBT's) shall convert DC bus voltage to variable frequency and voltage.

b. PWM sine coded output to the motor.

D. The ASD must be selected for operation at carrier frequencies at or above 10 kHz without derating to satisfy the conditions for current, voltage and horsepower as indicated on the equipment schedule. Exception to this requirement is allowed only for ASDs providing 380 amps or more.

E. ASD shall have an adjustable carrier frequency: The carrier frequency shall have a minimum of five settings to allow adjustment in the field.

F. ASD shall include two independent remote reference inputs. One shall be 0-10 VDC.

The other shall be programmable for either 0-10 VDC or 4-20 ma. Either input shall respond to a programmable bias and gain.

G. ASD shall include a minimum of five multi-function-input terminals, capable of being programmed to determine their function when their state is changed. These terminals shall provide up to 20 functions, including, but not limited to:

1. Remote/local operation selection.
2. Detection of external overhead condition.
3. Remote reset.
4. Multi-step speed commands.

H. ASD shall include a 0-10 VDC analog output, proportional to output frequency, output current or output power, for either monitoring, or "speed tracking" the ASD.

I. ASD shall include at least one external fault input, which shall be programmable, for either a normally open, or a normally closed contact, for connection to firestats, freezestats, etc.

J. ASD shall include a power loss ride through of 2 seconds.

K. ASD shall include a front-mounted, sealed keypad operator, with a digital display, to provide complete programming, operating, monitoring, and diagnostic capability. Keys provided shall include commands for RUN, STOP, and RESET. Operating mode (auto or manual) and speed setting functions shall also be provided.

L. ASD display shall provide readouts of: output frequency in hertz, output voltage in volts, output current in amps, output power in kilowatts, DC bus voltage in volts, interface terminal status and fault codes. All displays shall be labeled in easy-to-read English LED readouts.

M. ASD unit shall include the following meters to estimate use of energy:

1. Elapsed time meter.
2. Kilowatt meter.

N. ASD shall be capable of PID (Proportional, Ingegral, Derivative) logic, to provide closed-loop setpoint control capability, from a remote reference.

O. ASD shall include loss of input signal protection, with a speed default to 80% of the most recent speed.

P. ASD shall include loss of input electronic thermal overload protection for both the drive and motor, profitable for variable or constant torque. The electronic motor overload shall be approved by UL. If the electronic thermal motor overload is not approved by UL, a separate UL approved thermal overload relay shall be provided in the ASD enclosure.

Q. ASD shall include the following programming functions:

1. Critical frequency rejection capability: 2 selectable, adjustable bands.

2. Auto restart capability: 0-10 attempts.

3. Stall prevention capability.

4. "S" Curve soft start capability.

5. "Speed Search" capability, in order to start a rotating load.

6. Fifteen preset volts per hertz pattern.

7. One adjustable volts per hertz pattern.

8. Current limit adjustment capability, from 30% to 200% of rated full load current of the ASD.

9. Anti "wind milling" function capability.

R. ASD shall include factory settings for all parameters, and the capability to be rest back to those settings.

S. ASD shall include the capability to adjust the following functions, while the ASD is running:

1. Acceleration adjustment from 0-3600 seconds.

2. Deceleration adjustment from 0-3600 seconds.

3. A minimum of five different preset speeds.

4. Analog output gain, to calibrate the signal for the application used.

T. Manual Bypass shall be provided. ASD and bypass components shall be mounted inside a common NEMA 1 enclosure, fully pre-wired, and ready for installation as a single UL listed device. Bypass shall include the following:

1. Input, output, and bypass contactors, to disconnect power to the ASD, when the motor is running in the bypass mode.

2. 115 VAC control transformer, with fused primary.

3. Thermal overload relay, to protect the motor while operating in the bypass mode.

4. Circuit breaker/disconnect switch, with a "through-the-door" handle mechanism.

5. Control and safety circuit terminal strip.

6. "Drive-Off-Bypass" selector switch.

7. Pilot lights for "Power On" and "Fault".

8. "Normal/Test" selector switch, to allow testing and adjustment of the ASD, while the motor is running in the bypass mode.

9. "Auto/Manual" selector switch, to provide convenient switching between

"manual" and "auto" modes.

U. The frequency drive shall have the ability to communicate to the Landis & Staefa "apogee" system 600 Building management system. As a minimum the following points will be provided. All points will be transmitted across the Landis & Staefa P-1 network by a single pair of wires from each ASD. Drives requiring individual wires for each point are not acceptable.

1. Frequency output.

2. Drive temperature.

3. Drive kWh.

4. Drive runtime.

5. DC bus voltage.

5. Override time.

7. Stop/start command.

8. Current limit.

9. Panel status (opened/closed).

10. Selector switch status (hand/auto).

11. Fault alarm.

12. Frequency output override command.

13. Frequency setpoint command.

2.5 PRODUCT OPTIONS

A. Manual Bypass Options:

1. "Auto Transfer to Bypass Upon Drive Fault," to automatically transfer power across the line, and continue motor operation, in the event of an ASD fault.

2. "Smoke Purge," to command full speed while bypassing the overload circuits to "purge" the building in case of emergency.

2.6 FABRICATION

A. Enclosures: NEMA Type 1.

2.7 SOURCE QUALITY CONTROL

A. In-circuit testing of all printed circuit boards shall be conducted, to insure the proper mounting and correct value of all components.

B. All printed circuit boards shall be burned in for 96 hours, at 85 deg. C.

C. Final printed circuit board assemblies shall be functionally tested, via computerized test equipment. All tests and acceptance criteria shall be preprogrammed. All test results shall be stored as detailed quality assurance data.

D. All fully assembled controls shall be functionally tested, with fully loaded induction motors. The combined test data shall then be analyzed, to insure adherence to quality assurance specifications.

E. Inspection and production test, under load, each completed ASD assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that surface is suitable for ASD installation.

B. Do not install ASD until the building environment can be maintained, within the service conditions required by the manufacturer.

3.2 INSTALLATION

A. Install ASD where indicated in accordance with manufacturer's written instructions and NEMA ICS 3.

B. Tighten accessible connections and mechanical fasteners after placing ASD.

C. Provide neatly typed label on each ASD, identifying nameplate horsepower, full load amperes, model number, service factor, and voltage/phase rating.

3.3 FIELD QUALITY CONTROL

A. Field inspection and testing to be performed under provisions of Section 01400 "Quality Control."

B. Inspect completed installation for physical damage, proper alignment, anchorage, and grounding.

3.4 MANUFACTURERS' FIELD SERVICES

A. Prepare and start systems under provisions of Section 01400 "Quality Control."

3.5 ADJUSTING

A. Adjust work under provisions of Section 01700 "Contract Closeout." Make final adjustments to installed ASD, to assure proper operation of fan systems.

End of Section 15171

SECTION 15190 - MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Extent of mechanical identification work required by this Section is indicated in this Section, on the drawings, or where specified in other sections of Division 15.

1. Carefully examine all of the sections of Division 15 for the extent of nameplates, valve tags, identification signs and painting specified in each section. Note that many nameplates are specified under Section "Automatic Control Systems."

2. Provide valve tags for various valves as hereinafter specified.

3. Provide nameplates, signage, and various identification for pipe, ducts, equipment, etc., as hereinafter specified.

B. Types: Types of identification devices specified in this Section include the following:

1. Plastic Pipe and Duct Markers
2. Painted Identification.
3. Valve Tags.
4. Valve Schedules and Frames.
5. Engraved Plastic Nameplates and Signs.

C. Other Divisions: Refer to other divisions of the specifications for:

1. Field Painting.
2. Manufacturer's Nameplates.

1.2 QUALITY ASSURANCE

A. Codes: Installation of identification work shall conform to the requirements of American National Standards Institute (ANSI) A13.1, "Scheme for the Identification of Piping Systems."

1.3 SUBMITTALS

A. Division 1: Refer to Section 01003, "Submittals," for basic information relating to submittal requirements.

B. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device proposed under this Contract.

C. Samples: Submit three samples of each of the following:

1. 18 gauge painted sheet steel, grey background with red lettering of the style and size proposed for mechanical equipment identification, stenciled or painted with the words, "Mechanical Identification Scheme."

2. Brass valve tag engraved as specified, with valve chain and hook.

3. Plastic duct and pipe markers.

4. Plastic equipment markers.

5. Engraved plastic laminate nameplates.

D. Schedules: Submit a sample valve schedule, with protective facing and mounting plate.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (Not Used)

2.2 PAINTED IDENTIFICATION MATERIALS

A. Stencils: Provide metal stencils of letter sizes complying with ANSI A13.1 for piping, ductwork, casings, air handling units, pumps, motors and major pieces of mechanical equipment.

1. Provide lettering minimum 1-1/2-inch height for ductwork, piping and major pieces of mechanical equipment.

2. Provide lettering minimum 3/4-inch height for access doors, operational signs and the marking of small pieces of mechanical equipment.

B. Paint: Provide exterior grade stenciling enamel either brushing or spraying grade.

C. Colors: Provide colors conforming with the requirements of ANSI Z53.1, "Safety Color Code for Marking Physical Hazards" of sizes and styles in conformance with ANSI A13.1.

Color Name	Federal Highway Administration Designation
Safety Red	Highway Red No. 1
Safety Orange	Highway Orange No. 2
Safety Yellow	Highway Orange No. 3
Safety Green	Highway Green No. 4
Safety Blue	Highway Blue No. 5

2.3 PLASTIC PIPE MARKERS

A. Snap-On Type shall be a pre-printed, semi-rigid, snap-on, color-coded identification sleeve complying with ANSI A13.1.

B. Pressure Sensitive Type shall be pre-printed, permanent adhesive, color-coded, pressure sensitive, vinyl pipe markers conforming with ANSI A13.1.

1. Submit samples of pressure sensitive types, and submit manufacturer's data on permanence of adhesion, for approval.

2. Secure each end of markers with one of the following:

a) 24-gauge aluminum or stainless steel bands, 3/8-inch width, located 1 inch from the ends of the markers.

b) Nylon bands.

c) Flexible plastic adhesive bands wrapped tightly around on themselves.

C. All markers shall have directional arrows where applicable.

2.4 PLASTIC DUCT MARKERS

A. Laminated Plastic Type: Provide laminated plastic, color coded duct markers on insulated and un-insulated ductwork. All duct markers shall have directional arrows.

1. Overprint duct markers with black lettering not less than 1-1/4-inch (32 mm) in height and indicating:

a. Supply Air
b. Return Air
c. Outside Air
d. Exhaust Air
e. Relief Air

2. Attach with mechanical fasteners, pop rivets or welded stick clips, 6 inches (150 mm) on center. Markers may be securely glued to ductwork; however pre-attached adhesive backing is not acceptable.

B. In lieu of laminated plastic duct markers, stenciled markers may be used conforming to ANSI A13.1.

C. All duct markers shall have directional arrows.

2.5 VALVE TAGS

A. Materials: Provide valve tags of 18 gauge solid polished brass with engraved lettering or numbers.

2. Fill lettering or numbers with black paint.

3. Lettering shall be not less than 1/4-inch, in height.

4. Numbers shall be not less than 1/2-inch in height.

5. Provide 5/32-inch diameter hole, brass chain and "S" hook for attachment to the valve stem.

2.6 DIRECTIONAL ARROWS

A. Flow Direction: Provide flow directional arrows either as part of duct and pipe markers or separately, attached to pipes and ducts.

1. Conform to requirements for markers.

2. Size to conform to ANSI A13.1.

PART 3 - EXECUTION

3.1 CONCEALED VALVES AND EQUIPMENT

A. Equipment Above Ceilings: Provide valve tagging and identification to equipment located above ceilings, such as variable air volume boxes, valves, traps, and other items before the ceilings are installed.

B. Finished Surfaces: Where identification is to be provided on surfaces which require insulation, painting and finishing, install identification after covering and painting is complete.

3.2 DUCTWORK

A. General: Identify air supply, return, exhaust, relief and outside air intakes with approved duct markers and/or stenciled painted lettering. Identify in a number of places or as directed by Government Representative.

1. Include directional arrows.

2. Include number or identification of air handling unit or fan, etc.

3. Include CFM and other information where directed.

B. Visibility: Identify ductwork and casings where exposed in mechanical equipment rooms or visible in shafts, crawl spaces and other accessible locations outside of finished spaces.

1. Provide duct identification beginning at supply or exhaust fans and, thereafter, not greater than 20 feet on centers to the termination point or the point of concealment

C. Air Handling Equipment: Provide stencilled or engraved nameplates on all air handling equipment to identify the unit number and area served. Lettering size shall be not less than 1-1/2-inch in height, visible and readable from a distance of 30 feet..

3.3 PIPING SYSTEM IDENTIFICATION

A. General: Install pipe markers of one of the following types on each system indicated to receive identification, and include arrows to show normal direction of flow:

1. Stencilled markers, including color-coded background band or rectangle, and contrasting lettering of black or white. Extend color band or rectangle 2 inches beyond ends of lettering.

2. Stencilled markers, with lettering color complying with ANSI A13.1.

3. Plastic pipe markers, with application as indicated under "Plastic Pipe Markers" paragraph in this Section. Where hot non-insulated pipes require plastic pipe markers, employ one of

the following methods:

a) Insulate a section of the pipe, and place the markers on the insulation.

b) Use snap-on markers, with wooden block stand-offs secured to the pipe with metal bans, or secured to the markers.

4. Stencilled markers, black or white for best contrast, wherever continuous color-coded painting of piping is provided.

B. Locations for exposed, non-fire-related pipe: Locate pipe markers as follows wherever piping is exposed to view in occupied spaces, machine room, accessible maintenance spaces (accessible shafts, walk-through plenums), exterior concealed locations, and concealed gas piping. Provide markers:

1. Near each valve and control device.

2. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.

3. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.

4. At access doors, manholes and similar access points which permit view of concealed piping.

5. Near major equipment items and other points of origination and termination.

6. Spaced at maximum of 35 feet along each piping run, except reduce spacing to 24 feet (8 meters) in congested areas of piping and equipment.

C. Locations for <u>concealed</u>, non-fire-related pipe:

On piping above removable acoustical ceilings, 50 feet on centers. Gas and other accessible concealed locations, apply markers as specified above for exposed pipe, except that markers shall be maximum of 26 feet apart.

D. Gas Piping: Paint exposed gas pipe throughout (except chromium plated).

E. Locations for Fire-Related pipe:

1. Exposed pipe:

a) Fire mains standpipes, and fire sprinkler <u>mains</u>:

Shall have markers at maximum 13 feet apart, unless pipe is painted red throughout. In either case, include arrows. Where the pipes are vertical, apply at least one marker per floor on each pipe.

b) Fire sprinkler <u>branch</u> lines:

Need not have markers when sprinkler heads are visible (otherwise, apply markers). Directional arrows shall be included where directed in field by Government Representative.

2. Concealed pipe:

Apply markers as specified for exposed pipe, except that spacing shall be maximum 13 feet apart. Where sprinkler heads are visible above removable acoustic ceiling, sprinkler branch lines shall be marked as specified above for exposed branch lines.

3.4 VALVE TAGS AND SCHEDULES

A. Valve Tags: Provide valve tags for all manual valves, except exclude the following types of valves:
   1. Valves that are the normal supply and return shutoff valves for mechanical equipment where the valves are close to the equipment.
   2. Isolation service valves around auxiliary items such as steam traps, in-line filters, and the like.
   3. Valves on drains and air vents.
   4. Blowdown valves on strainers.
   5. Balancing valves or cocks.
   6. Also exclude the following: Exclude check valves, valves within factory fabricated equipment units, plumbing fixture faucets, convenience and lawn-watering hose bibs, and shut-off valves at plumbing fixtures and at HVAC terminal devices.

B. Valve Tags, Additional: Also provide valve tags for the following types of valves:
   1. Automatic valves (in addition to nameplates generally specified under section "Automatic Control Systems").
   2. Safety valves.
   3. Temperature-relief and pressure-relief valves.
   4. All other valves not specifically excluded.

C. Valve Schedule: List each tagged valve in valve schedule, for each piping system. Note that some valves, which are not tagged, are still required to be on valve schedule.

D. Valve Schedule Location: Mount valve schedule frames and schedules in machine rooms where indicated or where directed.

3.5 MECHANICAL EQUIPMENT IDENTIFICATION

A. General: Install engraved plastic laminate sign on or near each major item of mechanical equipment. Provide signs for the following general categories of equipment and operational devices:

1. Main control and operating valves.

2. Pumps, compressors, chillers, condensers and motor driven units.

3. Heat exchangers, evaporators, heat recovery units.

4. Fans, blowers, and primary balancing dampers.

5. Packaged HVAC central-station units.

6. Tanks and pressure vessels.

7. Filters, humidifiers, and water treatment systems.

B. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

3.6 CROSS CONNECTION IDENTIFICATION

A. Where piping, or duct, cross connections occur or where flow may be in different directions under different circumstances, piping or ducts shall be identified fully with signage such as "Cross connection between 200-ton chiller system and 1000-ton chiller system," and with arrows going both ways, one identified as "CHS from 200-ton" and the other identified as "CHS from 1000-ton." Exact wording shall be as directed by Government representative.

3.7 ADDITIONAL IDENTIFICATION

A. For New-construction projects: Contractor shall allow in his bid to provide 10% more signage than required by specifications.

B. For Alteration projects, contractor shall provide an additional 20% more signage of each type (pipe, duct, equipment, instruction signage) than required by specifications, some of which will be applied to existing-to-remain work, as directed.

C. Wording and placement of additional identification shall be as directed by Government Representative in field. Signage, as directed, shall identify pipes, ducts, etc. in terms of areas served and equipment supplying, etc. Some signage on pipes, ducts, and equipment shall be as extensive as this example: "CHS to AHU A-11-23 in 2nd Floor Utility Closet, serving 3rd Floor Courtroom."

3.8 COLOR AND IDENTIFICATION SCHEDULE

A. Provide final coat of paint, label surface, or lettering of color listed below:

COLOR, STENCIL AND VALVE TAG SCHEDULE

Service:	Color: (Field/Letters)	Stencil:	Tag:
Cold Water	Blue	Cold Water:Potable	C
Hot Water	Blue	Hot Water:Potable	H
Hot Water Circulating	Blue	Hot Water Car.:Potable	HWC
Fire Protection	Red/White	Fire Line	F
Sprinkler	Red/white	Sprinkler	S
Drinking Water Supply	Blue	Drinking Water Supply	DWS
Drinking Water Return	Blue	Drinking Water Ret.	DWR
Chilled Water Supply	Green/White	Chilled Water	CH
Chilled Water Return	Green/White	Chilled Water Ret.	CHR
Refrigeration Suction	Grey	Refrigeration Suction	RS
Refrigeration Liquid	Grey	Refrigeration Liquid	RL
Compressed Air	Black	Air kPa	A__
Sanitary Sewer	Black	San. Sewer	SAN
Storm Sewer	Black	Storm Sewer	SS
Condensate Drain	Black	Condensate	CD Drain
High Pressure Steam	Orange/ Black	H.P.Steam kPa	HPS ____
High Pressure Condensate Return	Orange/ Black	H.P.Drip kPa	HPR ____
Low Pressure Steam	Orange/ Black	L.P.Steam kPa	LPS ____
Low Pressure Condensate Return	Orange/ Black	L.P. Cond. Ret.	LPR
Heating Water Supply	Orange/ Black	Heat. Water Sup.	HWS

COLOR, STENCIL AND VALVE TAG SCHEDULE

Service:	**Color: (Field/Letters)**	**Stencil:**	**Tag:**
Heating Water Return	Orange/ Black	Heat. Water Ret.	HWR

END OF SECTION 15190

SECTION 15240 - VIBRATION ISOLATION

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: The extent of vibration isolation work to be provided under this Contract is covered by the requirements of this Section, Section 15010, "Mechanical Basic Requirements," and the Contract Drawings including structural, architectural, mechanical and electrical which identify equipment and systems requiring vibration isolation treatment.

B. Types: Types of vibration isolation equipment and systems specified in this Section include:

TYPE	DESCRIPTION
1I Isolator	Ribbed Neoprene Pads
2I Isolator	Neoprene-In-Shear Type
2H Hanger	Rubber-In-Shear Type
3I Isolator	Open Spring Type
3H Hanger	Combination Spring and Neoprene Type
4 Isolator	Vertically Restrained Spring Isolators

C. Selection of Isolators: Provide isolators selected by a vibration isolator equipment specialist.

1. Conform to isolator types herein specified.

2. Examine the contract drawings for sizes, equipment power ratings, rotational speeds, equipment location, length of span between columns and beams and construction type to determine the isolator selection type and deflection required for each piece of mechanical equipment.

3. Conform to the requirements of the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Handbook, "HVAC Systems and Applications," Chapter 52, "Sound and Vibration Control."

1.2 QUALITY ASSURANCE

A. Codes: Conform to the ASHRAE Handbook, "HVAC Systems and Applications," Chapter 52.

B. Manufacturer: Isolators of the same type shall be the product of the same manufacturer. The manufacturer shall publish and maintain a full line of materials, engineering and application data and operating and maintenance instructions.

1.3 SUBMITTALS

A. Division 1: Refer to Section 01003, "Submittals" for basic information relating to submittal requirements.

B. Contractor's Certification: Vibration isolator submittals shall include a certification, signed by an officer representing the Contractor and stipulating that the submittal prepared by the manufacturer has been reviewed, and checked on an item by item basis against each piece of mechanical equipment, shown or specified in the Contract Documents, which requires vibration isolation.

C. Manufacturer's Certification: The manufacturer or manufacturers (if there are more than one) shall each certify that the selections of vibration isolation equipment are based upon the drawings and specifications, and that each piece of mechanical equipment has been examined for rotational speed, equipment type, mounting location, and supporting span between column centers, and that an appropriate isolator has been selected.

D. Product Data: Furnish manufacturer's product data covering each isolator type for style, characteristic, and finish.

1. Isolator quantities, dimensions, deflections, capacities and types shall remain the responsibility of the manufacturer and the Contractor.

E. Shop Drawings: Providelayout drawings, drawn to a scale of not less than 1/4-inch to 1-foot, (1:50), showing the proposed layout of equipment and piping systems and the location and type of each vibration isolation device.

1. Carefully examine other sections requiring coordinated shop drawings, including but not limited to Section 15510, "Hydronic Piping Systems," Section 15520, "Steam and Steam Condensate Piping Systems," and Section 15890, "Sheet Metal Ductwork," and prepare isolation shop drawings to the same scale showing the location of each vibration isolation equipment base, pipe hanger, flexible connection, and isolator.

1.4 STORAGE AND PROTECTION

A. Storage: Store vibration isolation equipment indoors in the manufacturer's original shipping containers. Preclude the entrance of construction dirt and debris.

1. Vibration isolation equipment and bases, which show signs of rust, cement or concrete fouling, dirt and construction debris shall be disassembled and cleaned, approved or removed from the project site and replaced with new.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (Not Used)

2.2 EQUIPMENT

A. Dimensions: The schedule shows dimensions for deflection and sizes all in inches (millimetre).

B. Spans: Where referenced, the schedule shows spans of the longest bay dimension for slabs or beams supported between columns. Dimensions are in feet (millimetre).

C. Selection: Exact mounting sizes, dimensions and quantity of isolators and static deflection required shall be determined by the isolator manufacturer based upon equipment that will be furnished and installed by the Contractor under this Contract.

1. Vibration isolation specialist shall coordinate his work with that of other trades to verify that equipment speeds, in revolutions per minute (rpm), are based upon actual equipment installed at the project site.

2. Verify that equipment rpm and spring deflection selected are arranged so that resonance is avoided.

2.3 ISOLATOR TYPES

A. Type 1I Isolators: Provide pad type vibration isolators consisting of either two layers of 3/8-inch (10 mm) thick elastomer, molded to contain a pattern with non-slip characteristics in all directions, and bonded to 16 gauge (1.6 mm) galvanized steel separator plates, or 25 1-inchmm thick precompressed molded fiberglass isolation pads. Minimum overall thickness shall be 1-inch. (25 mm.) Deflection shall be limited to 0.25 inches6 mm or less. Loading shall not exceed 40 pounds per square inch. (275 kPa.)

B. Type 2I Isolators: Provide double rubber-in-shear or elastomer-in-shear with molded-in steel reinforcement in the top and bottom portions.

1. Deflections shall be limited to 0.5 inches (13 mm) or less.

2. Steel bases shall be drilled with mounting holes and equipment-mounting points shall be threaded male or female connections.

3. Treat resilient material with antiozone and antioxidant additives.

C. Type 2H Hangers: Provide rubber-in-compression suspension hangers, consisting of a formed steel frame and elastomer isolation element and provided with attachments for top and bottom suspension rods.

1. Design for a minimum 200 percent overload without noticeable deformation or failure.

2. Design for minimum 30 degree (0.50 rad) misalignment without binding or reducing the efficiency of the hanger.

3. Metal components shall be galvanized and factory painted.

D. Type 3I Isolators: Provide adjustable, freestanding, open spring isolators with combination leveling and equipment fastening bases.

1. Spring elements shall be contained in upper and lower housing assemblies and shall have a minimum Kx-Ky of 0.75.

2. Design springs for a minimum travel of 50 percent beyond the rated load.

3. When fully compressed and "bottomed-out", isolators shall be capable of

supporting a 200 percent overload without deformation and spring failure.

4. A minimum 1/4-inch (6 mm) thick non-skid isolation pad shall be bonded to the underside of the base plate.

5. Size base plates to limit floor loading to 100 pounds per square inch. (675 kPa.)

6. Drill base plates for bolting.

7. Provide means for anchoring the top element of the isolator to rails and equipment.

E. Type 3H Hangers: Provide combination spring and elastomer hangers consisting of a formed steel frame with coil spring and elastomer insert in compression.

1. Design hangers to be capable of supporting a 200 percent overload without noticeable deformation or failure.

2. Design hangers to allow a 30 degree0. (5 rad) misalignment without binding or a reduction in hanger efficiency.

3. Design hangers for connection to equipment and supporting rods.

F. Type 4 Isolators: Provide vertically restrained, freestanding, laterally stable, open spring type isolators.

1. Design for deflection exceeding 1/2-inch. (13 mm.)

2. Provide built-in bearing and leveling provisions.

3. Provide a minimum 1/4-inch (6 mm) thick non-slip elastomer vibration-absorbing pad bonded to the underside of the isolator base.

4. Outside diameter of each spring shall be equal to or greater than 0.9 times the operating height of the spring under rated load.

5. Provide vertical limit stops to prevent hyperextension due to wind loads or upward movement when the load is removed. Limit stops shall not bind or inhibit spring movement during normal operating ranges.

2.4 VIBRATION ISOLATION SYSTEM SELECTION

A. General: The following selections of vibration isolation equipment systems shall be considered as a minimum. For the equipment below, the following code applies:

Letter (i.e. A, B, C) = Base type
Number (i.e. 1, 2, 3, 4) = Isolator type
Decimal number (i.e. 0.25, 1.5, etc.) = Minimum deflection (inches)

TYPE BASEMENT 6 METER 9 METER 12 METER
EQUIPMENT BELOW-GRADE FLOOR-SPAN FLOOR-SPAN FLOOR-SPAN

TYPE BASEMENT 20-FOOT 30-FOOT 40-FOOT
EQUIPMENT BELOW-GRADE FLOOR-SPAN FLOOR-SPAN FLOOR-SPAN

A. Low-Pressure AHU Locations to 3 inch WG (To 700 Pa)

TYPE	BASEMENT	6 METER	9 mETER	12 METER
EQUIPMENT	BELOW-GRADE	FLOOR-SPAN	FLOOR-SPAN	FLOOR-SPAN
Through 10hp (7.5kW)	A 2 0.25	A 3 0.75	A 3 1.0	A 3 1.0
15hp (10kW) and over 250 to 500rpm (25rad/s to 50 rad/s)	A 2 0.35	A 2 1.5	A 3 1.75	A 3 1.75
500rpm (50 rad/s)	A 2 0.35	A 3 1.0	A 3 1.5	A 3 1.75

B. High-Pressure AHU Locations (3-inch W.G. –700Pa- and above)

TYPE	BASEMENT	6 METER	9 METER	12 METER
EQUIPMENT	BELOW-GRADE	FLOOR-SPAN	FLOOR-SPAN	FLOOR-SPAN

TYPE	BASEMENT	20-FOOT	30-FOOT	40-FOOT
EQUIPMENT	BELOW-GRADE	FLOOR-SPAN	FLOOR-SPAN	FLOOR-SPAN
Through 20 hp	A 3 0.35	A 3 1.0	A 3 2.0	A 3 2.5
Over 20 hp	A 3 1.0	A 3 1.5	A 3 2.5	A 3.0

C. Air-Moving Device Locations

Vibration-isolation provisions apply to housed or unhoused freestanding fans of any pressure rating, located in field-erected central-station units or in unhoused return-air or supply-air service.

PE	BASEMENT	6 METER	9 METER	12 METER
EQUIPMENT	BELOW-GRADE	FLOOR-SPAN	FLOOR-SPAN	FLOOR-SPAN

TYPE	BASEMENT	20-FOOT	30-FOOT	40-FOOT
EQUIPMENT	BELOW-GRADE	FLOOR-SPAN	FLOOR-SPAN	FLOOR-SPAN
Up to 5hp (4kW)	A/B 2 0.25	B 3 1.0	B 3 1.0	B 3 1.5
5 Through 40hp (30kW)				

200 to 500rpm (20 to 50 rad/s)	B 3 1.5	B 3 1.5	B 3 1.5	B 3 2.5
500rpm (50 rad/s) and Over	B/C 3 0.75	C 3 1.5	C 3 1.5	C 3 1.5

PART 3 - EXECUTION

3.1 INSTALLATION

A. Manufacturer: All vibration isolation equipment shall be installed in accordance with the manufacturer's recommendations.

B. Manufacturer's Representative: The vibration isolation installation and deflection testing after equipment start-up shall be conducted by a representative of the manufacturer.

3.2 TESTS AND REPORTS

A. Testing: Each vibration isolation device shall be deflection tested. Two copies of a bound report shall be submitted prior to final acceptance. The certification shall include the following:

1. Certify that equipment has been isolated in accordance with Contract Drawings, specifications and submittals.

2. Certify that all minimum specified deflections have been equaled or exceeded.

3.3 ANCHORING

A. Installation: Installation shall comply with manufacturer's published recommendations and shall be installed so that isolators are plumb and are operating at a manner for which they were designed.

1. Unless otherwise specified, all equipment shall be securely bolted to isolators, steel bases or concrete inertia bases.

2. Indoor vibration isolators need not be attached to the structure unless required by local codes.

3. Isolators installed outdoors shall be attached to building structure.

3.4 CLEANING

A. Debris: Remove all debris from under equipment, and thoroughly clean steel bases, inertia bases and check for free movement.

B. Adjustment: Adjust isolators as required for proper operation prior to starting equipment. Testing of vibration isolators shall be performed by a certified representative of the manufacturer as specified.

END OF SECTION 15240

SECTION 15250 - MECHANICAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Extent of mechanical insulation required by this Section is indicated on the drawings, by the requirements of this Section, and Section 15010, "Mechanical Basic Requirements."

B. Types: Types of mechanical insulation specified in this Section include the following:

1. Fiberglass pipe insulation.
2. Cellular glass pipe insulation.
3. Flexible unicellular pipe insulation.
4. Fiberglass duct insulation.
5. Cellular glass duct insulation.
6. Fiberglass equipment insulation.
7. Insulation jackets.
8. Insulation accessories.

C. Related Sections: Refer to other sections of Division 15 for the following:

1. Supports and Anchors
2. Mechanical Identification
3. Plumbing Piping Systems and Plumbing Specialties
4. Plumbing Equipment
5. Hydronic Piping Systems
6. Steam and Steam Condensate Piping and Specialties
7. Sheet Metal Ductwork
8. Fibrous Glass Ductwork

D. Other Divisions: Refer to other divisions of the specification for the following:

1. Painting: Division 9.

E. Definitions: Unless otherwise specified, interpret these words as follows:

1. Finished Spaces: All areas except furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces and tunnels.

2. Concealed Insulation: Insulation not visible in a finished space or in pipe shafts, furred spaces, above ceilings.

3. Exposed Insulation: Insulation visible in a finished or unfinished space.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Provide insulation conforming to the following standards:

1. American Society for Testing and Materials (ASTM): Manufacture and test

insulation in accordance with the ASTM standards, including:

a.	C 165	Recommended Practice for Measuring Compressive Properties of Thermal Insulation.
b.	C 167	Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations.
c.	C 177	Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
d.	C 195	Specification for Mineral Fiber Thermal Insulating Cement.
e.	C 302	Test Method for Density of Preformed Pipe-Covering-Type Thermal Insulation.
f.	C 303	Test Method for Density of Preformed Block-Type Thermal Insulation.
g.	C 305	Test for Thermal Conductivity of Pipe Insulation.
h.	C 411	Test for Hot-Surface Performance of High Temperature Thermal Insulation.
i.	C 449	Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
j.	C 547	Specification for Mineral Fiber Preformed Pipe Insulation.
k.	C 552	Specification for Cellular Glass Block and Pipe Thermal Insulation.
l.	C 553	Specification for Mineral Fiber Blanket and Felt Insulation (Industrial Type).
m.	C 592	Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered).
n.	C 612	Specification for Mineral Fiber Block and Board Thermal Insulation.
o.	C 921	Practice for Determining Properties of Jacketing Materials for Thermal Insulation
p.	E 84	Test Method for Surface Burning Characteristics of Building Materials.

2. American Society of Heating, Refrigerating, and air-conditioning Engineers (ASHRAE): Provide and install pipe and duct insulation in accordance with the

following ASHRAE standard:

a. 90 Energy Conservation in New Building Design.

3. Military Specifications: Provide PVC valve and fitting covers and other PVC material in accordance with the following Military Specifications:

a. LP-535E PVC Rigid Sheeting and Strips
b. LP-1035 Rigid RVC Materials

4. National Fire Protection Association (NFPA): Manufacture insulation in accordance with the following NFPA standards:

a. 255 Test, Methods, Surface Burning Characteristics of Building Materials.

B. The following materials are exceptions to the flame/smoke rating requirements specified above:

1. Nylon anchors for securing insulation to ducts or equipment.

2. Cork or treated wood inserts used between shields and piping at hangers on low-temperature piping.

3. Factory premolded one piece PVC fitting and valve covers.

4. Flexible unicellular insulation with smoke developed rating not exceeding 150.

C. Do not provide materials with flameproofing treatments subject to deterioration due to the effects of moisture or high humidity.

D. Flame/Smoke Rating: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method. In addition, the products, when tested, shall not drip flame particles, and flame shall not be progressive. Provide Underwriters Laboratories Inc., label or listing, or satisfactory certified test report from an approved testing laboratory to prove that fire hazard ratings for materials proposed for use do not exceed those specified.

E. Corrosiveness: Provide insulation such that when tested in accordance with the following test, the steel plate in contact with the insulation shows no greater corrosion than sterile cotton in contact with a steel plate for comparison.

1. Test Specimen: Two specimens shall be used, each measuring 1 inch by 4 inch (25 mm by 100 mm) thick.

2. Apparatus: Provide a humidity test chamber in which two polished- steel test plates 1 inch wide, 4 inches long and 0.020 inch (25 mm wide, 100 mm long and 0.5. mm thick) shall be placed. Plates shall be clear finish, cold-rolled strip steel, American quality, quarter hard, temper No. 3, weighing 0.85 lb./sq. ft. (4.15 kg/$m^{2)}$.

3. Procedure: The steel test plates shall be rinsed with cp. benzol until their surfaces are free from oil and grease and allowed to dry. One piece of cold-rolled steel shall be placed between the two insulation specimens and secured with tape or twine. The test specimen and uncovered plate shall be suspended vertically in an atmosphere having a relative humidity of 95 percent plus or minus 3 percent, and a temperature of 120 degrees plus or minus 3 degrees F (50 degrees C, $\pm$ 1.5 degrees C) for 96 hours, and then be examined for corrosion.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, K-value, thickness, and furnished accessories for each mechanical system requiring insulation. Also furnish necessary test data certified by an independent testing laboratory.

B. Maintenance Data: Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product data in maintenance manual.

C. Samples: Submit manufacturer's sample of each piping insulation type required, of glass cloth required and of each duct and equipment insulation type required. Affix label to sample completely describing product.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver insulation, coverings, cements, adhesives, and coating to the site in containers with manufacturer's stamp or label affixed showing fire hazard indexes of products.

B. Storage and Handling: Protect insulation against dirt, water, chemical, and mechanical damage. Do not install damaged or wet insulation; remove from project site.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (Not Used)

2.2 INSULATION GENERAL REQUIREMENTS

A. General: Provide insulation conforming with the referenced publications and the specified temperature ranges and densities in pounds per cubic foot (pcf) (kilograms per cubic meter (kg/m^3)).

B. Insulation Exterior: Provide insulation exterior that is cleanable, grease resistant, non-flaking, and non-peeling.

C. Physical Changes: Provide insulation that shows no physical changes that adversely affect its qualities under normal use at the intended use temperature.

2.3 FIBERGLASS PIPE INSULATION

A. General: Provide fiberglass pipe insulation conforming to ASTM C 547 Class 1 jacketed.

B. Fittings, Flanges, and Valves: Provide insulation for fittings, flanges, and valves premolded, precut, or job fabricated of the same thickness and conductivity as used on adjacent piping.

2.4 CELLULAR GLASS PIPE INSULATION

A. General: Provide cellular glass pipe insulation conforming to ASTM C 552, Type II (pipe and tubing),, 9.5 pcf (150 kg/m$^{3)}$ (average) maximum. Provide cellular glass pipe insulation for temperatures of minus 450 degrees F. to 800 (-265°C to 425°C).

B. Fittings, Flanges, and Valves: Provide insulation for fittings, flanges, and valves premolded, precut, or job fabricated of the same thickness and conductivity as used on adjacent piping.

2.5 FIBERGLASS DUCT INSULATION

A. General: Provide fiberglass duct insulation for exposed and concealed spaces as follows:

1. For exposed insulation, provide rigid fiberglass duct insulation conforming to ASTM C 612 block and board, Class 1 (temperature to 400 degrees F.,(205 degrees C), non-load bearing, 10-pcf.

2. For concealed insulation, provide rigid fiberglass insulation as specified above or provide flexible fiberglass duct insulation with minimum 1-1/2 pounds per cubic foot (24 kg/m$^{3)}$ density and with factory applied vaporproof jacket ASTM C 921, Type I.

2.6 FIBERGLASS EQUIPMENT INSULATION

A. General: Provide fiberglass equipment insulation for exposed and concealed spaces as follows:

1. For exposed insulation, provide rigid fiberglass equipment insulation conforming to ASTM C 612, block and board, Class 1 (temperature to 400 degrees F.,(205 degrees C), non-load bearing, 10 pcf (160 kg/m$^{3)}$ average, maximum.

2. For concealed insulation, provide rigid fiberglass insulation as specified above or provide flexible fiberglass equipment insulation conforming to ASTM C 553, Type I (Resilient, Flexible), Class B5 (up to 400 degrees F., 2.0 pcf {205 degrees C, 32 kg/m$^{3\}}$ nominal.

2.7 INSULATION JACKETS

A. General: Provide insulation jackets in accordance with ASTM C 921. Test insulation jacket as a composite with the insulation.

B. Type I or II: Provide jacket Types I or II complying with ASTM C 921.

1. Use Type I, vapor barrier type on cold piping, cold ductwork and cold equipment.

2. Use Type II, water vapor permeable type on hot piping, hot ductwork and hot equipment.

C. Beach Puncture: Provide jacket Type I and II beach puncture per Federal Specification (FS) HH-B-100, "Barrier Material Vapor (For Pipe, Duct and Equipment Thermal, Insulation)."

D. Type III: Provide protective jacket made of sheet aluminum in accordance with ASTM B 209, 3003 alloy, H-14 temper, 0.016-inch (0.4 mm) thick. Provide a moisture barrier lining except where applied directly over a Type I vapor barrier jacket. Provide screw-lock stainless steel bands.

2.8 GLASS CLOTH COVERING

A. Weight of glass cloth shall be not less than 7.8 ounces per square yard.

B. Glass cloth shall be pre-sized.

2.9 PVC PIPE AND VALVE COVERS

A. Polyvinyl chloride (PVC) covering shall be pre-molded type for valves and pipe fittings. PVC fitting covers shall meet Military Specification LP-535E and LP-1035 as applicable.

2.10 INSULATION ACCESSORIES

A. General: Provide insulation accessories compatible with materials to which applied and suitable for the service. Provide insulation accessories that do not corrode, soften or otherwise attack the insulation or jacket in either the wet or dry state.

B. Adhesives, Coatings, Sealing Compounds, and Protective Finishes: Provide adhesives, coatings, sealing compounds, and protective finishes in the following categories:

1.	Category 1	Lagging Adhesive and Coating for Glass Cloth Jackets and other Facings.
2.	Category 2	Lap Adhesive for Vapor Barrier Jackets.
3.	Category 3	Insulation Cement per ASTM C 195 (100 to 1600 degrees F.),(40 degrees C to 870 degrees C), mineral fiber, thermal conductivity 0.12 W/m degrees C maximum at 95 degrees C mean when tested per ASTM C 177.
4.	Category 4	Contact Type Adhesive for Installing Flexible Unicellular Insulation.
5.	Category 5	Bedding Compound and Joint Sealers.
6.	Category 6	Coating Compound - Vapor Barrier Treatment (For Indoor Use Only).

C. Staples: Provide outward clinching type staples, 3/4-inch (19 mm) nominal width, of metal.

D. Bands: Provide bands of galvanized steel, aluminum, brass, or nickel copper alloy of (3/4-inch) 19 mm nominal width. Provide band thickness exclusive of coating not less than

0.005-inch (0.12 mm) for steel and nickel copper alloy, 0.007-inch (0.18 mm) for aluminum, and 0.01-inch (0.25 mm) for brass.

E. Wire: Provide wire of 14-gauge (2 mm) nickel copper alloy or copper clad steel, or 18-gauge, (1.3 mm), soft annealed galvanized steel.

F. Wire Netting: Provide wire netting for exposed surface of insulation to be cement finished. Provide wire netting that is 22-gauge, 1-inch (0.85 mm, 25 mm) galvanized mesh, with continuous 26-gauge (0.55 mm) galvanized steel corner beads having 2-1/2-inch (65 mm) wings.

G. Corner Angles: Provide corner angles on insulation of exposed ducts and exposed equipment formed of 28 gauge, 1-inch by 1-inch (0.5 mm 25 mm by 25 mm) aluminum adhered to 2-inch by 2-inch (50 mm by 50 mm) heavy kraft paper to protect external corners under field applied jackets or facings.

PART 3 - EXECUTION

3.1 GENERAL INSULATION INSTALLATION

A. General: Install insulation material with smooth and even surfaces. Unless otherwise specified, install insulation materials, accessories and finishes in accordance with the manufacturer's published recommendations.

B. Surface Condition: Do not apply insulation materials until all surfaces to be covered are clean and dry; all foreign materials, such as rust, scale, and dirt have been removed; and, where specified, surfaces have been painted. Insulation shall be clean and dry when installed and during the application of any finish. Do not install the insulation on pipe fittings, valves and pipe joints before the piping is pressure tested and approved.

C. Moisture and Vapor Seal: Provide a complete moisture and vapor seal wherever insulation terminates against metal hangers, anchors and other projections through insulation on cold surfaces for which a vapor seal is specified.

D. Jackets: Provide jackets as follows:

1. Install jackets drawn tight with all joints having laps or butt strips of material identical with jacket, secured with adhesive or vapor barrier compound. Provide jackets on piping with not less than 1-1/2- inch (40 mm) laps at longitudinal joints and not less than 3-inch (80 mm) wide butt strips at end joints. Provide jackets on blanket, board and block insulation with 2-inch (50 mm) wide laps or 3-inch (80 mm) wide butt strips. Seal all openings, punctures and breaks in vapor barrier jackets with vapor barrier compound, Category 6.

2. On all exposed insulation, provide a glass cloth jacket directly over the Type I or II jacket, painted as specified.

E. Installation of Glass Cloth Covering:

1. Locations:

a. Glass cloth covering shall be installed over Type I and Type II jackets specified, below 8 ft (2450 mm) elevation, in all exposed areas, including mechanical equipment rooms. Glass cloth covering need not be installed on pipes and ducts in chases, shafts, furred ceiling spaces, below floors, and the like.

b. Glass cloth covering shall be installed on all valves and elbows, not just those that are exposed, as specified below.

c. Glass cloth covering need not be installed where Type III aluminum jackets are installed.

2. Methodology: The glass cloth shall be neatly fitted and secured with a full coat of lagging adhesive, Category 1. All seams shall be lapped at least 50 mm. Painting: If not otherwise specified, glass cloth covering shall be painted with two coats of Interior Flat Latex Base Paint, conforming to Federal Specification TT-P-29.

F. Valves and Elbows

1. Insulate as specified for the service involved and cover all surfaces of the insulation with glass cloth, glass tape or glass fabric of 40 by 40 or 20 by 20 (1.66 mm by 1.6 mm or 0.8 mm by 0.8 mm) mesh embedded between two 1/16-inch (1.5 mm) thick coats of vapor barrier compound Category 6. Install the fabric drawn smooth and tight with a 2-inch (50 mm) overlap at all joints.

2. In lieu of glass cloth covering on valves and elbows and operating at temperatures above 2 C., one-piece pre-molded valve and elbow covers made of polyvinyl chloride (PVC) may be used. Covers shall overlap the adjoining pipe covering and vapor barrier jackets.

a. The insulation underneath the PVC covers shall be maintained at the same density as the insulation on the adjoining piping and shall be continuous with the pipe insulation, with no gaps.

b. Where the piping operates at a temperature above ambient, the PVC covers all be secured at all edges with adhesives, Category 2, or staples.

c. Where the piping operates at a temperature between ambient and 2 C., the PVC covers shall be secured and sealed at all edges with adhesive, Category 2, and the ends shall be wrapped with pressure sensitive vinyl tape. The tape shall overlap the jacket of the adjoining pipe insulation and shall overlap on itself at least 2 inches (50 mm).

G. Wall and Floor Openings: Install insulation and coating of jackets continuous through wall and floor openings, except at fire dampers and smoke dampers.

H. Insulation Thickness: Provide insulation of thickness corresponding to the following tables:

TABLE 1
PIPE INSULATION THICKNESS INCHES NOMINAL)

Calcium Silicate (CS), Cellular Glass (CG), Flexible Unicellular (FU), and FiberGlass (FG).

TEMPERATURES (degrees F.)	PIPE DIAMETERS (Inches)				
	0.25-1.25	1.5-3	4-5	6-10	12-36
Minus 30 to Zero					
FG	1.5	2	2.5	2.5	3
CG	2	2.5	3	3	3.5
Zero to 34					
FG	1.5	1.5	2	2	2.5
CG	2	2	2.5	2.5	3
35 to 59					
FG	1	1	1.5	1.5	1.5
CG	1	1.5	1.5	1.5	2
FU	1	1	1	1	1
60 to 200					
FG	1	1.5	1.5	2	2
CG	1.5	1.5	1.5	2	2
CS	1.5	1.5	1.5	2	2
FU	1	1	1.5	1.5	1.5
(210 Max.)					
201 to 250					
FG	2	2	2.5	2.5	3
CG	2	2.5	3	3.5	3.5
CS	2	3	3	3.5	4
251 to 375					
FG	2.5	3	4	4	4
CG	2.5	3	4	4	4.5
CS	2.5	3	4	4	5
376 to 500					
FG	3	3.5	4.5	5	5
CG	3.5	4	5	5.5	6.5
(450 Max.)					
CS	3	3.5	4.5	5	6
501 to 700					
FG	3	3.5	4.5	5	5
CS	3	3.5	4.5	5	7
701 to 900					

FG (850 Max.)	3.5	4.5	6	6.5	7
	0.25-1.25	1.5-3	4-5	6-10	12-36
CS	3.5	4	5	6.5	7

TABLE 1
PIPE INSULATION THICKNESS MILLIMETERS NOMINAL)

Calcium Silicate (CS), Cellular Glass (CG), Flexible Unicellular (FU), and FiberGlass (FG).

TEMPERATURES (degrees C)	PIPE DIAMETERS (Millimeters)					
	6.5-32	40-80	100-125	150-250	300-900	
-34 to -17	FG	40	50	65	65	80
CG	50	65	80	80	90	
-17 to 1						
FG	40	40	50	50	65	
CG	50	50	65	65	80	
1.5 to 15						
FG	25	25	40	40	40	
CG	25	40	40	40	50	
FU	25	25	25	25	25	
15.5 to 93						
FG	25	40	40	50	50	
CG	40	40	40	50	50	
CS	40	40	40	50	50	
FU	25	25	40	40	40	
(100□C Max.)						
94 to 120						
FG	50	50	65	65	80	
CG	50	65	80	90	90	
CS	50	80	80	90	100	
121 to 190						
FG	65	80	100	100	100	
CG	65	80	100	100	115	
CS	65	80	100	100	130	
191 to 260						
FG	80	90	115	130	130	
CG	90	100	130	140	170	
(230□C Max.)						
CS	80	90	115	130	155	
260 to 370						
FG	80	90	115	130	130	
CS	80	90	115	130	180	
	6.5-32	40-80	100-125	150-250	300-900	
371 to 480						

FG	90	115	155	165	180
(455□C Max.)					
CS	90	100	130	165	180
481 to 650					
CS	100	155	180	200	200

TABLE 2
EQUIPMENT INSULATION THICKNESS

Calcium Silicate (CS), Cellular Glass (CG), and FiberGlass (FG).

TEMPERATURES (degrees F.)	THICKNESS (inches) CS	CG*	FG
Minus 30 to 60	NA	6	5.5
Brine Chilling	NA	6	5.5
60 to 100	NONE	NONE	NONE
100 to 150	2	2	2
151 to 250	3	2.5	2.5
251 to 350	4	3.5	3
351 to 500	4.5	6.5*	4.5
501 to 700	6	NA	5
701 to 900	7	NA	7
901 to 1200	8	NA	NA
1201 to 1500	10	NA	NA
1501 to 1800	12	NA	NA

NA: Not applicable.

* 450 degrees F.

TEMPERATURES (degrees C)	THICKNESS (millimeter) CS	CG*	FG
-34 to 16	NA	155	140
Brine Chilling	NA	155	145
16 to 38	NONE	NONE	NONE
39 to 65	50	50	50
66 to 121	80	65	65
122 to 177	100	90	80
178 to 260	115	165*	115
261 to 370	155	NA	130
371 to 482	180	NA	180
483 to 650	200	NA	NA
651 to 815	255	NA	NA
816 to 980	305	NA	NA

NA: Not applicable.
* 230 degrees C max.

3.2 INSULATION FOR PLUMBING PIPING AND EQUIPMENT

A. General: Unless otherwise specified, insulate plumbing piping and equipment.

B. Location Insulated: Install insulation in the following locations and as indicated:

1. Cold water piping, except pipes used exclusively for fire protection.

2. Hot water supply and recirculating piping.

3. Roof, plaza, road and other surface water drainage piping in ceiling spaces and in roof spaces, and where exposed in finished spaces.

4. Water storage tanks, water heaters.

5. Piping used only for wastes from drinking fountains, water coolers, room unit coolers, room air conditioning units, and piping handling Condensate only from cooling and dehumidification equipment.

C. Locations Not Insulated: Do not install insulation in the following locations:

1. Brass or copper piping or tubing specified to be chrome plated.

2. Self-contained water heaters with storage tanks, where the insulation for this equipment is installed at the factory.

3. Unions, flanges and valve bonnets on piping below 3-inch IPS. (80 mm).

D. Refrigerated Drinking Water System: Insulate as specified under "Insulation for Low Temperature Piping" article, of this Section.

E. Domestic Water System Tanks and Pumps: Insulate pneumatic tanks and pumps of domestic water system as specified under "Insulation for Refrigerating Equipment" article, of this Section.

F. Insulation Thickness: Insulate plumbing piping with insulation thickness specified in Table 1. Insulate plumbing equipment with insulation thickness specified in Table 2. Provide preformed insulation for plumbing piping, except flexible unicellular insulation, with factory applied Type I jackets.

G. Fittings and Valves: Insulate fittings and valves with insulation thickness specified in Table 1. Install insulation flush with adjacent pipe insulation.

H. Gaps and Terminations: Except for flexible unicellular insulation, neatly terminate all insulation at each end of unions and at other points where required and seal with coating compound 6. Fill gaps occurring at hangers with insulating cement and finish flush with the adjoining pipe insulation as specified for fittings.

I. Hot Water Storage Tanks and Water Heaters: Provide insulation for hot water storage tanks and water heaters as specified in Part 2 of this Section. Secure blocks with wires or bands

spaced not over 9 inches (225 mm) on center, and fill all joints, seams, and chipped edges with proper type of insulating and finishing cement as specified under "Insulation Accessories" article, of this Section. Apply galvanized wire netting securely fastened and pulled down tight on exposed insulated surfaces, and cover the wire netting with a smoothing coat of insulating and finishing cement not less than 13 mm thick and sufficient to remove all surface irregularities and finish with glass cloth covering.

J. Flexible Unicellular Insulation Application: Install flexible unicellular insulation as follows:

1. Slip flexible unicellular pipe insulation on the seal pipe prior to connection wherever possible, and the butt joints with adhesive, Category 4, as specified under "Insulation Accessories" article, of this Section.

2. Where the slip-on technique is not possible, slit the insulation and apply to the pipe, seal the seams and butt joints with adhesive, Category 4, as specified under "Insulation Accessories" article, of this Section.

3. Where pipe hangers are used outside of the insulation, protect the insulation from compression as specified under "Insulation for Low Temperature Piping" article, of this Section.

4. Insulate all fittings and valves (except unions, flanges and valve bonnets) in piping insulated with flexible unicellular insulation with similar pipe or sheet insulation of the same thickness.

5. Seal all joints at fittings and valves with adhesive, Category 4, as specified under "Insulation Accessories" article, of this Section.

6. Insulate screwed fittings with sleeved fitting covers fabricated from miter-cut pieces of pipe insulation according to the manufacturer's sleeving size recommendations and overlap and seal to the adjacent pipe insulation.

7. Insulate all valves and welded fittings with fitting covers fabricated from similar pipe insulation or sheet insulation.

3.3 INSULATION FOR HEATING

A. General: Unless otherwise specified insulate piping and equipment for steam and hot water heating systems.

B. Locations Insulated: Install insulation in the following locations and as indicated:

1. All supply and return piping and equipment.

2. Boiler feed piping.

3. Condensate return and vacuum pump discharge pipe to boiler.

4. Condensate storage tanks, flash tanks, economizers, converters, deaerator tanks, and blow-off tanks.

5. Medium and high-pressure system pumps.

6. Diesel engine coolant water piping, exhaust piping and mufflers.

7. Supply and return runouts from risers to convectors where concealed in floor construction, dropped ceilings, or shafts and where exposed below floor or ceiling construction.

8. Fittings, unions, flanges, and valves, except for valve bonnets on low-pressure systems.

9. Expansion joints.

10. Unions and flanges on medium-pressure and high pressure steam and water supply and return piping.

C. Locations Not Insulated: Do not install insulation in the following locations:

1. Exposed radiator and convector supply and return runouts located less than 6 ft (1800 mm) above floor.

2. Ends of low-pressure steam mains for a distance of 4 ft (1200 mm) from thermostatic and combination float and thermostatic drip traps.

3. Valve bonnets on low-pressure systems.

D. Insulation Thickness: Insulate the heating system with the following insulation thickness:

1. Insulate heating system piping with insulation thickness specified in Table 1.

2. Insulate heating system equipment with insulation thickness specified in Table 2.

3. For expansion joints and pumps, provide same insulation thickness as that required for adjoining piping.

4. For supply piping in rooms containing medium-pressure or high-pressure boilers and for all steam piping at pressure reducing valve stations, regardless of pressure, provide thickness shown in Table 1 for temperatures 376 to 500 degrees F. (190 degrees C to 260 degrees C).

5. For converters, provide same insulation thickness as shown in Table 1 for pipes 12 to 36 inch (300 to 900 mm) in size in same temperature class.

E. Block Insulation: Install block insulation for use on piping and equipment operating at temperature above 600 degrees F. (315 dgrees C) applied in double layer construction with staggered joints.

F. Pipe Insulation Jackets: Except for calcium silicate, provide preformed insulation for heating piping with factory-applied jacket, Type II.

G. Fittings and Valves: Provide fittings and valves with insulation. Install insulation for system with temperatures less than 250 degrees F (120 degrees C) systems, install insulation of the same thickness as the pipe insulation with jackets.

H. Gaps and Terminations: Neatly terminates insulation at flanges and unions. Fill gaps occurring at hangers with insulating cement and finish flush with the adjoining pipe insulation.

I. Unions, Flanges and Valve Bonnets: Provide unions, flanges, and valve bonnet for other than low-pressure systems, with readily removable sectional insulation of same composition and thickness as the pipe covering.

J. Type III Jackets: Provide and install protective jackets, Type III, to permit removal and reinstallation of the insulation without damage for the following; expansion joints; pumps; booster heaters on dishwashing machines; and exposed and insulated steam supply and Condensate return connections serving steam operated sterilizers, cooking equipment and laundry equipment [and steam turbines].

K. Breachings: Insulate breachings for low-pressure boilers, and diesel engine exhaust piping and mufflers, with blocks or molded pipe insulation applied over 3/4-inch (19 mm) rib expanded metal lath. Secure insulation with bands or wires spaced not over 9 inches (230 mm) on centers. Provide insulation for low-pressure boilers suitable for use at 1000 degrees F. (540 degrees C). Provide insulation for diesel engine exhaust piping suitable for use at 1200 degrees F. (650 degrees C).

L. Induced Draft Fans, Fly Ash and Soot Collectors, Uptakes and Flues from Boiler Outlets, and Breachings for Medium-Pressure and High-Pressure Boilers: Provide induced draft fans, fly ash and soot collectors, uptakes and flues from boiler outlets, and breachings for medium-pressure and high pressure boilers with blocks secured firmly on a rigid framework surrounding the equipment. Form the framework of No. 6 gauge (4 mm) dia. welded wire mesh, of not over 6-inch by 6-inch (150 mm by 150 mm) spacing, or of equal steel rod construction, with the framework welded to stiffeners. Fit blocks carefully and hold in place by wire tied to the metal framework. Provide insulation suitable for use at 1000 degrees F. (535 degrees C) or higher.

M. Heating Boilers, Oil Heaters, and Hot Water Converters: Provide heating boilers, oil heaters, and hot water converters covered with blocks held in place by wires spaced not over 9 inches (230 mm) on centers. Provide a smooth finish at all bottom edges of boiler water legs or top of boiler base. Carefully bevel and secure insulation to boiler. Do not cover manholes, handholes, cleanouts, ASME stamp, boiler manufacturer's name and catalog number, but carefully bevel the insulation around same.

N. Wire Netting and Corner Beads: Provide insulation for all breachings, fans, and boilers, specified in the preceding paragraphs with wire netting and metal corner beads applied after blocks are wired in place, and cover with a 1/4-inch (6 mm) coat of insulating and finishing cement trowelled to a smooth covering and finished with glass cloth or canvas.

3.4 INSULATION FOR LOW-TEMPERATURE PIPING

A. General: Unless otherwise specified, insulate low-temperature piping.

B. Locations Insulated: Install insulation in the following locations and as indicated:

1. Liquid line for air-cooled condensers and evaporative condensers for systems operating with an outside air temperature lower than 40 degrees F.(4 degrees C).

2. Drinking water piping.

3. Chilled water piping.

4. Exposed dehumidifier spray piping.

5. Dual-temperature piping (with alternate heating and cooling).

C. Insulation Thickness: Insulate lows temperature piping with insulation thickness specified in Table 1.

D. Refrigerant Hot Gas and Liquid Lines and Condenser Water Piping: Insulate refrigerant hot gas and liquid lines and condenser water piping, where exposed in air conditioned or refrigerated spaces, as specified for hot water piping under "Insulation for Heating Piping and Equipment" article, of this Section. Insulate other condensing water piping, operating at less than 50 degrees F. (10 degrees C) any time of the year.

E. Preformed Insulation: Provide preformed insulation for low-temperature piping, except flexible unicellular insulation, with factory applied jackets, Type I.

F. Fittings, Flanges, and Valves: Insulate all fittings, flanges, and valves (except valve stems, hand wheels and operators) with insulation of the same thickness as adjacent pipe insulation.

G. Pipe Support: Support insulated low temperature piping by hangers and metal protection shields, conforming with MSS SP 58, Type 40 installed outside of the insulation. Provide one of the following on all piping 2 inch (50 mm) and larger, where pipe insulation is of less than 9 lbs.4 kg density, except for cellular glass:

1. An insulation insert with a density of 9 lbs. or more, 12-inches (4 kg or more, 300 mm long), and covering at least 90 degrees (1.5 rad) of the pipe surface transmitting the pipe weight.

2. Protection saddles, prefabricated to include the insert material, and vapor barrier jacket.

H. Anchor Insulation: Where anchors are secured to piping to be insulated, insulate the anchor the same as piping for a distance at least four times the insulation thickness, to prevent condensation. Except for unicellular insulation, vapor seal all insulation as previously specified for fitting insulation.

I. Flexible Unicellular Insulation: Install flexible unicellular insulation as follows:

1. Slip flexible unicellular pipe insulation on the pipe prior to connection wherever possible, and seal the butt joints with adhesive, Category 4, as specified under "Insulation Accessories" article, of this Section.

2. Where the slip-on technique is not possible, slit the insulation and apply to the pipe, seal the seams and butt joints with adhesive, Category 4, as specified under "Insulation Accessories" article, of this Section.

3. Protect flexible unicellular insulation from compression at all pipe hanger locations by the use of compression resistant inserts and protective metal shields. Provide inserts of the same thickness and outside contour as the adjoining insulation, mold or shape to fit at least 90 degrees of the pipe circumference, and seal into adjoining pipe insulation with adhesive, Category 4, as specified under "Insulation Accessories" article, of this Section.

4. Insulate all fittings, flanges and valves (except valve stems, hand wheels and operators) in piping insulated with flexible unicellular insulation with similar pipe or sheet insulation of the same thickness.

5. Seal all joints at fittings and valves with adhesive, Category 4, as specified under "Insulation Accessories" article, of this Section.

6. Insulate screwed fittings with sleeved fitting covers fabricated from miter-cut pieces of pipe insulation according to the manufacturer's sleeking size recommendations and overlap and seal to the adjacent pipe insulation.

7. Insulate all valves and welded fittings with fitting covers fabricated from similar pipe insulation or sheet insulation.

3.5 INSULATION FOR REFRIGERATING EQUIPMENT

A. General: Unless otherwise specified, insulate low-temperature equipment.

B. Insulation Thickness: Insulate the refrigerating equipment with the following insulation thickness:

1. Chilled water storage, expansion, and balancing tanks – 3inch (80 mm).

2. Chilled water pumps – 2 inch (50 mm)

3. Drinking water storage tanks (chilled) - 3-inch (80 mm)

4. Drinking water pumps – 2 inch (50 mm)

C. Blocks or Board: Provide blocks or boards with a minimum dimension of 12 inches (300 mm) and a maximum dimension of 48 inches. (1200 mm). Install block or board insulation to fit as closely as possible to the refrigerating equipment, and stagger end joints where possible. Where insulation thickness specified is over 2 inches, (50 mm), install the insulation in double layer construction with staggered joints. Provide the insulation for cylindrical surfaces with edges properly beveled to provide a tight joint. Hold all sections of insulation in place with bands spaced 9 inches (230 mm) on centers. Join all sections of cellular glass insulation with bedding compound, Category 5.

D. Removable Insulation: Install the insulation on heads of coolers and on other parts of equipment that must be opened periodically for inspection, cleaning, and repair so insulation can be removed and replaced without damage. Install insulation with metal covers, as

complete units or in sections, and with all necessary supports.

E. Pumps: Insulate pumps required to be covered with boxes of the thickness specified; fit the boxes around the pumps and coincide splits with the splits in the pump casings. Provide boxes that are metal covered. Hold and draw the sections of the boxes together with bolts. At the joints between the sections, protect the insulation by means of metal bands around each section formed to provide a vapor sealed telescopic fit.

F. Vapor Barrier: Coat insulation with two coats of vapor barrier compound, Category 6, applied with an open weave glass fabric between the coats, same as described for low-temperature fittings. Point up all punctures and breaks with vapor barrier coating, Category 6.

G. Wire Netting: Fasten galvanized wire netting securely and pull tight over all surfaces. Cover the wire netting with a smoothing coat of insulating and finishing cement not less than 1/4-inch , 6 mm thick and sufficient to remove all surface irregularities.

H. Glass Cloth Jacket: Apply glass cloth over the entire surface except do not apply cloth over metal covers.

I. Surface Finish: After the insulation is in place on the areas to be insulated, except where metal encased, fill all joints, seams chipped edges, or depression with bedding compound, Category 5, to leave a smooth workmanlike surface. Apply surface finish before covering with glass cloth.

3.6 INSULATION FOR AIR HANDLING AND AIR DISTRIBUTION EQUIPMENT AND DUCTS

A. General: Unless otherwise specified insulate air handling and air distribution equipment.

B. Ventilation System Locations Insulated: Install insulation for ventilating systems with leaving temperature less than 90 degrees F. (32 degrees C) in the following locations and as indicated:

1. Ducts and apparatus from outdoor (outside, fresh) air intakes to supply fan inlet connection for fans located outside duct or casing. Entire casing shall be insulated where fan is located within casing.

2. Supply ducts in unheated spaces immediately below roof and in unexcavated spaces.

3. Heating coil enclosures.

C. Air Heating System Locations Insulated: Install insulation for air heating systems with leaving air temperatures of 90 degrees F. (32 degrees C) or more in the following locations and as indicated:

1. Ducts and apparatus from outdoor (outside, fresh) air intakes to supply terminals. ("Supply terminals" means Air Inlets and Outlets. It does not include VAV boxes and the like. These are "Air Terminal Units" in these specifications, not "Terminals".)

2. Return air ducts in unheated spaces immediately below roof and in unexcavated

spaces.

3. Heating coil enclosures and external headers.

D. Exhaust System Locations Insulated: Install insulation for exhaust systems in the following locations and as indicated:

1. Range and oven hood exhaust ducts and dishwasher exhaust.

E. Air Conditioning System Locations Insulation: Install insulation for air conditioning systems of all types, velocities and pressures, in the following locations and as indicated:

1. All ducts from outdoor (outside, fresh) air intakes to room supply terminals, including all casings, apparatus, sheet metal plenum chambers, bypasses, and mixing boxes.

2. Return ducts in finished spaces not provided with conditioned supply air.

3. Return ducts concealed in ceilings below roof, and in furred spaces adjoining any areas not provided with conditioned supply air.

4. Return ducts concealed in shafts with supply ducts and piping.

5. All factory prefabricated sound absorbers shall be insulated.

F. Locations Not Insulated: Do not install insulation in the following locations.

1. Fibrous glass ductwork.

2. Ducts, casings and air handling units where internal insulation or sound absorbing linings are specified under other sections of the specification.

3. Fan nameplates, access plates in fan housings and ducts. Frame insulation terminations with 22 gauge(0.85 mm) sheetmetal frames with hemmed edges.

4. Insulated flexible ductwork specified under other sections of the specifications.

G. Oven and Range Hood: Insulate oven and range hood exhaust ducts with 2-inch (50 mm) thick blocks or boards, either fiberglass (ASTM C 612, Class 5), calcium silicate (ASTM C 552) or nominal density fiberglass block (ASTM C 612, Class 4). Install the insulation with bands or wires spaced not over 9 inches (230 mm) on centers or with heavy welded pins spaced not over 12 inches (300 mm) apart each way. Do not use adhesives.

H. Air Handling and Air Distribution Equipment and Ducts: Provide insulation for air handling and air distribution equipment and apparatus (except oven and range hood exhaust ducts) of rigid blocks or boards with a minimum dimension of 12 inches (300 mm) and a maximum dimension of 48 inches, (1200 mm) except as follows:

1. Insulation for circular ducts exposed in finished spaces and less than 24 inches (600 mm) in diameter shall be preformed pipe insulation of materials and application as specified under "Insulation for Low Temperature Piping" article, of this Section, and

1-1/2-inch (40 mm) thick.

2. Insulation for circular ducts exposed in finished spaces and 24 inches (600 mm) or over in diameter shall be rigid blocks or boards or preformed pipe insulation. The preformed or block insulation shall be sized or cut, beveled, and scored to provide a complete and tight fit to the duct surface. Thickness shall be 1-1/2 inches. (40 mm).

3. Insulation for concealed ducts shall be either rigid blocks or boards or preformed insulation as specified in Table 2 or fiberglass flexible insulation and 1-1/2 inches (40 mm) thick.

4. Supply side channels and yokes of air-handling toffers which are not factory insulated shall be insulated as specified for the connecting ductwork, except that the as-installed thickness shall be not less than 1/2-inch. (15 mm).

5. Equipment, casings and apparatus in machine, fan, equipment rooms and penthouse equipment rooms shall be minimum 2 inches (50 mm) thick.

I. Block and Board Insulation: Install block and board insulation as follows:

1. Secure block and board insulation tightly and smoothly with not less than 50 percent coverage of bonding adhesive, Category 3, and with galvanized steel, aluminum, brass, or nickel copper alloy bands spaced not more than 12 inches (300 mm) apart. Protect the insulation under bands at corners with metal corner angles. On flat surfaces more than 30 inches (750 mm) wide, provide metal supports of same height as insulation and spaced not more than 24 inches (600 mm) apart. Provide the supports of either light angles or clips spot welded or otherwise securely attached to the duct or casing. Punch the supports with openings and pass the bands through these openings. After the insulation on air conditioning equipment and ducts is in place, fill all joints, seams and chipped edges with bedding compound, Category 5.

2. In lieu of securing the block and board insulation with adhesive and bands, secure the insulation tightly and smoothly with speed washers and welded pins. Space anchors or pins not over 18 inches (450 mm) apart each way, not over 3 inches (80 mm) from edges of insulation joints, and capable of supporting a load of 20 pounds (9 kg) per anchor or pin. Apply insulation with all joints in close mechanical contact and all open joints, breaks, punctures and voids in insulation on air conditioning equipment and ducts filled with vapor barrier coating compound, Category 5. Where anchors or pins are welded to ducts, use a welding procedure which will not distort the duct, will not burn through or mar the interior finish of the duct, but which will develop the full strength of the anchor. Provide anchor and pin sizes and diameters as recommended by the manufacturer for the type and thickness of the insulation specified.

J. Concealed Duct Flexible Insulation: Secure the flexible insulation for concealed ducts with long sides or diameters less than 24 inches (600 mm) tightly and smoothly with a bonding adhesive, Category 3, applied in 6-inch (150 mm) wide transverse strips on 12-inch (300 mm) centers. Secure the flexible insulation for ducts with long sides or diameters of 24 inches (600 mm) or more tightly and smoothly with metal or nylon anchors or pins, cemented or welded to the ducts as specified in "Block and Board Insulation" paragraph, of this Section, above spaced not more than 13 inches (330 mm) apart each way. Do not permit

sagging of the insulation and provide sufficient bonding adhesive or fasteners to prevent this.

K. Insulation Jackets: Provide insulation for air handling and air distribution equipment and ducts (except oven and range hood exhaust ducts) with jackets as specified under "Insulation Jackets" article, of this Section. Provide Type I jackets for air conditioning and Type II jackets for ventilating and air heating. For insulation on ventilating and air heating ducts and equipment, install the jackets at all joints with a 2-inch (50 mm) wide lap drawn tight and secured with staples on 4-inch (100 mm) centers and 1-inch (25 mm) from edges of laps.

END OF SECTION 15250

SECTION 15410 - PLUMBING PIPING SYSTEMS AND PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: The extent of plumbing piping work is indicated on the drawings, and by the requirements of this Section and Section 15010, "Mechanical Basic Requirements."

B. Related Sections: Refer to other sections of Division 15 for the following:

1. Plumbing Fixtures.

2. Mechanical Insulation.

3. Testing and Balancing.

4. Supports and Anchors.

C. Other Divisions: Refer to other specification divisions for:

1. Field Painting: Division 9.

2. Electrical Connections and Power Wiring: Division 16.

1.2 QUALITY ASSURANCE

A. Codes: Provide plumbing piping systems lay out and installation in accordance with the following plumbing codes:

1. WASHINGTON SUBURBAN SANITARY COMISSION (WSSC)

2. Building Officials and Code Administrators International (BOCA) "National Plumbing Code."

3. National Association of Plumbing-Heating-Cooling Contractors (NAPHCC) "National Standard Plumbing Code."

4. Southern Building Code Congress International (SBCCI) "Standard Plumbing Code."

B. Specimen Joints: Before commencing pipe laying, submit specimen joints of each type of piping system proposed for use under this Contract.

1. Upon approval of specimen joints, such joints shall form a standard of quality against which all subsequent piping joints will be judged.

C. Standards: Where national or industry standards are referenced, provide materials and equipment certified by the manufacturer to be in conformance with latest issue of such national standards. Conform to the following standards:

1. American National Standards Institute (ANSI):

a. A112.21.1M Floor Drains

b. A112.21.2M Roof Drains

c. A112.36.2 Cleanouts

d. B16.12 Cast Iron Threaded Drainage Fittings

e. B16.18 Cast Copper Alloy Solder Joint Pressure Fittings

f. B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

g. B16.23 Cast Copper Alloy Solder Joint Drainage Fittings

h. B16.29 Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings

i. B16.32 Cast Copper Alloy Solder Joint Fittings for Solvent Drainage Systems

2. American Society for Testing and Materials (ASTM):

a. A 47 Standard Specification for Ferritic Malleable Iron Castings

b. A 53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded Seamless

c. A 74 Standard Specification for Cast Iron Soil Pipe Fittings

d. A 183 Standard Specification for Carbon Steel Track Bolts and Nuts

e. A 216/ A 216M Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding for High-Temperature Service

f. A 276 Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes

g. A 307 Standard Specification for Carbon Steel Bolts and Studs 410,000kPa Tensile Strength

h. A 536 Standard Specifications for Ductile Iron Castings

i. B 32 Standard Specification for Solder Metal

j. B 43 Standard Specification for Seamless Red Brass Pipe, Standard Sizes

k. B 61 Standard Specification for Steam or Valve Bronze Castings

l. B 62 Standard Specification for Composition Bronze or Ounce Metal Castings

m. B 75 Standard Specification for Seamless Copper Tube

n. B 88 Standard Specification for Seamless Copper Water Tube

o. B 306 Standard Specification for Copper Drainage Tube (DWV)

p. B 584 Standard Specification for Copper Alloy Sand Castings for General Applications

q. C 62 Standard Specification for Building Brick (Solid Masonry Units Made From Clay or Shale)

r. C 478 Standard Specification for Precast Reinforced Concrete Manhole Sections

s. C 564 Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings

t. D 2000 Standard Classification System for Rubber Products in Automotive Applications

3. American Society of Sanitary Engineering (ASSE):

a. 1013-71 Performance Requirements for Reduced Pressure Principal Backflow Preventers -- with 1988 Revision

4. American Water Works Association (AWWA):

a. C111/A21.11 Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings

b. C110/A21.10 Ductile-Iron and Gray-Iron Fittings, 3in (76mm) Through 48in (1219mm), for Water and Other Liquids

c. C606 Grooved and Shouldered Joints

5. Cast Iron Soil Pipe Institute (CISPI):

a. 301 Hubless Cast-Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

b. 310 Patented Joint for Use in Connection with Hubless Cast-Iron Sanitary System

6. Federal Specifications (FS):

a. RR-F-621 Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole

7. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):

a. SP 70 Cast Iron Gate Valves, Flanged and Threaded Ends

b. SP 71 Cast Iron Swing Check Valves, Flanged and Threaded Ends

c. SP 80 Bronze Gate, Globe, Angle and Check Valves

d. SP 84 Steel Valves - Socket Welding and Threaded Ends

e. SP 85 Cast Iron Globe and Angle Valves Flanged and Threaded Ends

8. Plumbing and Drainage Institute (PDI):

a. G101 Testing and Rating Procedure for Grease Interceptors

b. WH201 Water Hammer Arrestors

1.3 SUBMITTALS

A. Manufacturer's Data: Submit standard manufacturer's published product literature for materials and equipment proposed for use under this Contract, including the following items:

1. Soil pipe and fittings.

2. Domestic water pipe and fittings.

3. Drainage piping and fittings.

4. Jointing methods and materials for all piping systems.

5. Valves - all types.

6. Traps - all types.

7. Area drains.

8. Wall hydrants.

9. Acid resistant piping.

10. Strainers.

11. Water hammer arrestors.

12. Access panels.

13. Roof drainage pipe and fittings.

14. Roof drains.

B. Coordinated Drawings: Provide coordinated shop drawings for plumbing piping work in toilet rooms, mechanical rooms, and sewage pumping areas as follows:

1. Draw to a scale of ½”=1’–0” (1:20) with sheet size equal to Contract Drawings.

2. Show plan with elevations and scaled fittings.

3. Show columns, beams, ductwork, mechanical piping, pullboxes, conduit, ceilings, floors, and pipe spaces.

C. Permits: Provide and pay for all permits and post, where directed, on the construction site.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (Not Used)

2.2 SANITARY DRAIN, WASTE AND VENT PIPING

A. Hub and Spigot Piping: Hub and spigot cast iron pipe, 16” (400mm) diameter and smaller, shall be either coated or uncoated service weight conforming to ASTM A 74.

1. Provide caulked and leaded joints or compression gasket joints conforming to ASTM C 564.

2. Provide fittings conforming to ASTM A 74.

B. Cast Iron Hubless Pipe and Fittings: Provide pipe and fittings conforming with CISPI 301 with CISPI 310 coupling joints.

C. Reducers: Provide eccentric reducers for changes in pipe size of soil, waste and drain lines.

D. Bends: Changes in direction, where space permits, shall be made with long sweep bends, Y fittings and 1/8 or 1/16 bends or combination Y and 1/8 bends.

1. Sanitary tee branches and 1/4 bends may be used for connection of branch lines to fixtures and from stacks to horizontal drainage.

2.3 ABOVE GROUND SOIL, WASTE, DRAIN AND VENT PIPING

A. Soil Pipe 3” (80mm) Diameter and Larger: Provide standard weight cast iron pipe with cast iron hub and spigot fittings conforming to ASTM A 74 with ASTM C 564 rubber compression gasket joints or caulked and leaded joints or cast iron hubless pipe and fittings with CISPI 301 fittings and CISPI 310 coupling joints.

B. Soil Pipe 2½” (65mm) and Smaller: Provide cast iron, galvanized steel, or copper waste lines.

1. Do not use copper for urinals.

2. Provide cast iron hubless pipe and fittings conforming to CISPI 301 with CISPI 310 coupling joints.

3. Provide cast iron hub and spigot pipe and fittings conforming to ASTM A 74 with ASTM C 564 rubber compression gasket joints or caulked and leaded joints.

4. Provide ASTM B 306 copper tubing with ANSI B16.23, ANSI B16.29 or ANSI B16.32 solder joint fittings using ASTM B 32 50/50 tin lead solder.

5. Provide steel piping conforming to ASTM A 53, Schedule 40 hot-dipped galvanized, threaded end connections with ANSI B16.12 hot-dipped galvanized recessed threaded drainage fittings.

C. Cleanouts: Provide threaded bronze cleanouts conforming to ANSI A112.36.2.

D. Floor Cleanouts: Provide cast iron floor cleanouts with anchor flange, polished bronze or nickel bronze rim and scored floor plate with the letters "CO" cast in the floor plate. Secure floor plate with countersunk stainless steel screws flush with finished floor.

E. Wall Cleanouts: Provide polished stainless steel or chromium-plated bronze cover plate and secure to the cleanout plug with stainless steel countersunk screws.

2.4 FLOOR DRAINS

A. General: Provide drains conforming to ANSI A112.21.1M, with cast iron bodies, grate, flashing clamping device, and outlet connections to suit piping furnished.

1. In mechanical rooms and other unfinished areas provide drains with cast iron grates.

2. In toilet rooms provide drains with polished nickel silver or chrome plated bronze grates, and removable sediment buckets.

B. Grate Sizes: For floor drains with outlet diameters of 3” (80mm), and 4” (100mm) provide grates with minimum free drainage areas of 280 square inches (7100 square millimeters) and 472 square inches (12000 square millimeters), respectively.

C. Extended Rim Floor Drains: Provide as specified for floor drains except strainer body shall have 1” (25mm) extended rim installed flush with the finished floor.

D. Traps: Provide cast iron P-traps on all floor drains.

1. For drains sizes of 3” (80mm) and 4” (100mm)) provide grates with minimum free drainage areas of 125” $(3200mm)^2$, 280” (7000mm) and 472” (12000mm), respectively.

2. Where indicated on the drawings provide area drains with polished nickel silver grates.

3. Where indicated on the drawings provide floor drain trap with a ½” (12mm) trap prime line. Provide a ½” (12mm) cast bronze trap prime valve with ½” (12mm) NPT or copper sweat connection. Trap prime line shall be connected to the domestic cold water supply pipe to a water closet.

2.5 WASTE AND VENT PIPING EXPOSED IN FINISHED AREAS

A. Materials: Provide red brass, standard weight iron pipe, size and thickness conforming to ASTM B 43, in toilet rooms, and other finished spaces. Finish shall be chrome plated.

B. Fittings: Provide threaded cast brass recessed drainage pattern fittings.

1. Joints between brass and ferrous pipe shall be threaded.
2. Chromium plated piping shall be carefully measured and cut so that not more than one full turn of thread is visible beyond the face of the adjacent fitting.

2.6 ABOVE GROUND WATER PIPING

A. Pipe 2" (50mm) and Larger: Provide piping conforming to ASTM A 53, Schedule 40 hot-dipped galvanized or copper tubing type ASTM B 88, Type L with ANSI B16.18 or ANSI B116.22 solder joint fittings using ASTM B 32 95-5 lead free solder.

1. Fittings for steel pipe shall conform with ASTM B 16.3 or ASTM B 16.4 and shall be hot-dipped galvanized.

B. Pipe and Fittings 1½" (40mm) and Smaller: Provide copper tubing, Type L, hard drawn conforming to ASTM B 88 with either wrought copper or cast brass recessed solder joint fittings.

1. Adaptors for connection to threaded valves and fittings shall be cast brass.

2. Solder shall be in conformance with ASTM B 32 tin lead-free solder.

2.7 ROOF DRAINS

A. General: Provide roof drains conforming to ANSI A112.21.2.

B. Material: Provide drains with hot-dipped galvanized cast iron bodies and domes.

C. Construction: Provide drains with minimum 10" (250 mm) diameter body, non-puncturing flashing clamp device with integral gravel stop and deck clamp. Free area of the dome shall not be less than 2 times the free area of the drain outlet.

D. Promenade or Deck Drains: Construct promenade or deck drains similar to roof drains except provide galvanized cast iron adjustable extension collars and polished nickel silver or red brass grates.

2.8 FLASHING

D. General: Provide sheet lead flashing, not less than 20 kg/m^2, or other approved flashing material certified by the roofing system manufacturer to be compatible with the roofing system.

2.9 ROOF DRAINAGE PIPING

D. Materials: Provide cast iron or galvanized steel roof drainage piping.

0. Cast iron piping and fittings shall be hub and spigot type, conforming to ASTM A 74 with ASTM C 564 compression gaskets or caulked and leaded joints, or

cast iron hubless pipe and fittings conforming to CISPI 301 with CISPI 310 coupling joints.

1. Steel pipe shall be ASTM A 53, Schedule 40, hot-dipped galvanized, threaded end connections with ANSI B16.12 hot-dipped galvanized threaded fittings.

E. Grooved End Piping: For roof drainage, grooved end steel pipe may be used with ASTM A 47 or ASTM A 536 hot-dipped galvanized grooved end fittings and mechanical couplings.

1. Coupling nuts and bolts shall be ASTM A 183.

2. Rubber gaskets shall be ASTM D 2000.

3. Fittings, couplings and gaskets shall be supplied by the same manufacturer.

2.10 VALVES: MAXIMUM 125psi (860kpa) SYSTEM WORKING WATER PRESSURE

A. Valves 1½" (40mm) and Smaller: On systems not exceeding 125psi (860kpa) water working pressure provide valves conforming to the following:

1. Construct valves of ASTM B 62 bronze in conformance with MSS SP 80, Class 125psi (860kpa).

2. Ends may be threaded or solder connection type.

3. Valves shall be gate, globe, or check valves as indicated on the drawings.

B. Gate, Globe and Check Valves 2" (50mm) and 3" (75mm) Diameter: Provide gate, globe and check valves conforming to the following:

1. Provide valves with bronze or cast iron bodies.

2. Bronze body shall conform to the requirements of valves 1 1/2" (40mm) and smaller.

3. Cast iron body shall conform to the requirements of valves 4" (100mm) and larger.

C. Gate, Globe, Check Valve 4" (100mm) and Larger: Provide gate, globe and check valves rated for 125psi (860kpa) water working pressure. Conform to the following:

1. Gate valves shall be cast iron or steel conforming to MSS SP 70, O.S.&Y. rising stem pattern, with bronze seats, solid wedge disc, bronze stem and flanged end connections.

2. Globe valves shall be cast iron or cast steel conforming to MSS SP 85, rising stem pattern with bronze seats, replaceable Teflon plug facing, bronze stem, and flanged end connections.

D. Handwheels: Provide handwheels of ductile iron, malleable iron or steel.

E. Check Valves, Swing Pattern: Provide swing pattern type check valves conforming to the requirements of MSS SP 71 and as follows:

1. Body shall be cast iron with flanged end connections, bronze disc holder, resilient disc, bronze seats, cast iron flanged cap and resilient gaskets.

F. Ball Valves Sizes 1 1/2" (40mm) and Smaller: On the systems not exceeding 125psi (860kpa) water working pressure and 250°F (120°C) temperature, ball valves may be used in lieu of gate valves. Conform to the following:

1. Construct valves in conformance with MSS SP 84, with carbon steel bodies, virgin Teflon seal rings, chrome plated carbon steel ball, bolted or top entry construction with threaded ends.

G. Ball Valves Size 2" (50mm) and Larger: On systems operating at 125psi (860kpa) maximum working water pressure and 250°F (120°C) temperature, ball valves conforming to the following shall be provided.

1. Construct valves in conformance with MSS SP 72, Class 150psi (1030kpa).

2. Ends shall be flanged.

3. Bodies shall be carbon steel ASTM A 216/A 216M.

4. Ball shall be stainless steel conforming to ASTM A 276-304 on sizes to 4" (100mm), and chrome plated carbon steel ASTM A 216/A 216M on valves sizes 6"(150mm) through 12" (300mm).

5. Stems shall be stainless steel ASTM A 276-316.

6. Glands shall be stainless steel, with stainless steel studs and nuts.

7. On valves 6"(150mm) and larger, provide manual gear operators, sized by the manufacturer, containing milled steel gears, oil lubricated and steel cast iron housing with bolted accessible maintenance plates, cast steel hand cranks or semi-steel gear wheels.

2.11 NON-SLAMMING OR SPRING LOADED CHECK VALVES

A. Types: Provide valves of the fully guided or coned and diaphragm types.

B. Bodies: Provide flanged or wafer type bodies constructed of cast iron ASTM A 216/A 216M, Class B; cast steel ASTM A 216/A 216M, Class WCB; stainless steel, Type 304 or cast bronze ASTM B 61.

C. Trim: Seats, discs and springs shall be constructed of 18-8 stainless steel or bronze complying with ASTM B 62. Seats may be of elastomers suitable for 250°F (120°C) minimum continuous working temperature or not less than 86°F (30°C) above the operating temperature of the system, whichever is higher.

D. Mating Surfaces: Mating surfaces of closure faces shall be bronze or Type 316 or 17-4PH stainless steel or elastomer approved for the particular service and materials must be compatible to prevent electrolytic action.

E. Pressure Loss: Pressure loss through the valves, measured in PSI (kPa), shall not exceed 6/10 (5.9) times the water velocity in FPS (m/s).

F. Bubble-Tight: Non-slamming and spring loaded check valves shall provide bubble-tight shutoff when handling water up to 250°F (120°C) and 125psi (860kpa) differential pressure. Design shall prevent rubbing of seat materials when opening and closing. Poppet valves shall have conical springs.

2.12 STRAINERS

A. Types: Provide strainers of the "Y" or basket types as indicated on the drawings or required to suit the field conditions.

B. Strainers 1 1/2” (40mm) Diameter and Smaller: Provide strainers with bronze bodies conforming to ASTM B 62, Grade C or cast iron bodies conforming to ASTM A 216/A 216M, Grade B.

1. End connections shall be threaded.

2. Screens shall be 18-8 stainless steel with 0.03” (0.8 mm) diameter perforations.

C. Strainers 2” (50mm) and Larger: Provide strainers with cast iron bodies conforming to ASTM A 216/A 216M, Grade B with flanged end connections or ductile or malleable iron bodies with grooved end connections.

1. Screens shall be bronze, monel metal, 18-8 stainless steel or 304 stainless steel.

2. Sizes 2” (50mm) to 6” (150mm) shall have 0.05”(1.5mm) diameter perforations.

3. Sizes 8” (200mm) to 12” (300mm) shall have 0.11” (3mm) diameter perforations.

D. Design Pressure: Provide strainers designed for 125psi (860kpa) working pressure on systems less than 125psi (860kpa). Provide 250psi (1,720kPa) design strainers for systems up to 250psi (1,720kPa) working pressure.

E. Strainer Free Area: The free area of each strainer screen shall be not less than three times the area of the strainer inlet pipe.

F. Drain Valves: For each strainer, provide a plugged ½” (13mm) diameter gate valve, bronze body, working pressure to match the strainer, threaded with a plugged outlet.

2.13 NON-FREEZE WALL HYDRANTS

G. Material: Provide copper alloy valve bodies with brass or stainless steel shafts, resilient valve seats and ductile iron or steel handwheels.

H. Arrangement: Provide hydrants with male threaded inlet connections, automatic draining vacuum breaker outlet with threaded male connection, and provide sufficient length to extend through walls to place the valve inside the building where it is not subject to freezing.

1. Arrange bonnet and stem to be removable from outside the building.

2.14 HOSE BIBBS

A. General: Provide angle type copper alloy globe valves with ductile iron or steel handles, lock shield type. Inlet shall have female threaded connection, outlet shall have vacuum breaker with ¾" (19mm) male hose threaded connection.

2.15 PRESSURE REDUCING VALVES

A. General: Provide pressure reducing valves of the self-contained direct operated type, in which special composition diaphragm and spring act directly on the valve stem.

B. Operation: Valve shall operate so that downstream pressure will not vary by more than 2psi (15kPa) over an inlet range in pressure from 60psi (410kPa) to 150psi (1,030kPa).

C. Construction: Valves 2" (50mm) and smaller shall be designed for a working pressure of 250psi (1,720kPa) and shall be all brass or bronze construction except that ductile iron or other suitable material may be used for non-wetted parts. Valves larger than 2" (50mm) shall be designed for a working pressure of not less than 200psi (1,400kPa) and shall have ductile iron bodies with bronze trim and flanged inlet and outlet connections.

D. Adjustment: Valve shall be adjustable to any required outlet pressure between 40psi (275kPa) and 125psi (860kpa).

E. Strainers: Do not provide integral strainers.

2.16 GROOVED PIPE FITTINGS

A. General: On systems operating at less than 125psi (860kpa) maximum water working pressure and 250°F(110°C) temperature, grooved mechanical fittings may be furnished in lieu of welded, flanged or screwed pipe connections.

1. Provide self-centering couplings, elbows and tees which shall engage and lock in place the grooved or shouldered pipe and fitting ends in a positive watertight joint.

2. Fitting shall be capable of providing not less than 0.035rad center line deflection without leakage for pipes up to 3" (75mm), 0.07rad for pipes up to 12" (300mm) and manufacturer's specified value for larger pipe.

3. Castings shall be malleable iron complying with ASTM A 47 or ductile iron conforming to ASTM A 536. Gaskets shall conform to ASTM D 2000, Grade E, EPDM elastomer.

4. Provide not less than 2 square, track head or oval neck steel bolts, heat treated carbon steel in conformance with ASTM A 183.

5. Elbows, tees, and coupling bodies shall be grooved, or shouldered and constructed of malleable iron castings conforming to ASTM A 47 or ductile iron Grade 65-45-12 in accordance with ASTM A 536. Copper fittings shall be constructed of ASTM B 75 or B 584.

6. Pipe grooving shall be performed in accordance with manufacturer's specifications for pipe sizes ¾”-24”(19mm through 600mm) diameter.

7. Flanged fittings and flanged or threaded end valves shall be connected to the grooved pipe system with grooved adapters.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Codes: Installation of plumbing systems including piping, equipment, materials and workmanship shall be in conformance with Washington Suburban Sanitary Commission plumbing code, except as modified herein.

B. Hot and Cold Water to Fixtures: When fixtures require both hot and cold water, provide the hot water supply to the left connection and the cold to right.

C. Threaded Connections: Jointing compound for pipe threads shall be PTFE pipe thread tape, pipe cement and oil or PTFE powder and oil.

3.2 DRAINAGE AND VENT PIPING INSTALLATION

A. Sanitary and Storm Drainage: Soil, waste, vent, and drain piping for sanitary and storm drainage including connections to city sewers, shall be of the sizes noted, and shall be run as indicated. Pipes must be run in straight lines and have a uniform grade between elevations noted. No branch drain shall have a grade less than that indicated for the main drain to which it is connected. Where elevations are not given, pipes shall have a uniform grade of 2% (1:50), except where such grade on overhead pipes would reduce the headroom substantially, the grade may be reduced to not less than 1% 1:100, where approved. Where conditions do not permit building drains and services to be laid with a fall as great as that specified, a lesser slope may be permitted, provided computed velocity is at least 1.65’/sec (0.5m/s). Keep all overhead pipes as close to the ceilings as possible, unless otherwise indicated or noted. Vent pipes shall project above roof line not less than 10”(250mm) nor more than 18”(450mm) unless other dimensions are noted on drawings.

B. Indirect Waste Connections: Indirect waste connections shall be provided for drains from condensate drip pans, from kitchen equipment such as steam tables, Bain-Marie, refrigerators, and other apparatus for storage, preparation or processing of food or drink, from sterilizing equipment, and from air compressors and similar equipment requiring cooling water. The indirect waste pipes must discharge into, and above the overflow rim of, slop sinks and floor drains, or through an air gap to the inlet side of a trap serving the fixture, device, or apparatus. The air gap shall have an opening at least twice the effective opening of the waste pipe. Vent connections to horizontal drains shall be made above the center lines of the drains, either at the top or at an angle of 45 degrees.

C. Rough-Ins: If required for future extensions, rough-ins shall extend to within the space to be served, and be capped or plugged.

D. Pipe Transitions: Changes in sizes of soil, waste, and drain piping shall be made with reducing fittings, tapered increasers, or fittings bushed in the sand. Changes in pipe sizes of vent pipes shall be made with reducing fittings or fittings bushed in the sand.

E. Fittings: Ends of threaded piping shall be cut square so as to seat in bottom of recess of fittings, and must be reamed out. All changes in direction of piping shall be made with fittings; bending of pipes shall not be permitted.

F. Pipe Connections: Threaded joints shall be made with a noncorrosive lubricant applied on the male thread only, shall be made metal to metal, and shall not be caulked to stop or prevent leaks. Long screws and bushings, except bushings cast in the sand, shall not be used on soil, waste, vent or drain piping.

G. Tucker Connections: Tucker connections shall be used where a union connection is required by field conditions.

3.3 INSTALLATION OF TRAPS

A. General: Running traps or P(1/2 S) traps shall be installed where shown on drawings, specified, or required by code. Traps shall be extra heavy cast iron, ASTM A 74. P(1/2 S) traps above ground that are accessible after completion of the building, shall have threaded brass cleanout plugs in the bottoms of same.

B. Cleanouts: Running traps (except trap on main sewer), shall have a cleanout on each side and, where trap is not accessible, cleanouts shall be extended up to floor level or grade and shall be provided with caulking ferrules and brass cleanout plugs with countersunk heads.

3.4 INSTALLATION OF CLEANOUTS AND FERRULES

A. Riser Connection to Sewer or Drain: Where soil, waste, or roof drainage risers connect to a sewer or drain extending from the building above the lowest floor, the fitting at the base of each stack or downspout shall be a sanitary tee or a combination Y and 1/8 bend with cleanout plug in the end of the run of the main.

B. Test Tees: Each vertical soil, waste, and vent pipe and each downspout and roof drainage pipe which connects to horizontal drain piping below ground shall be fitted with a test tee above the lowest floor or ground. Where accessible, test tee may be installed in the horizontal pipe at the base of the riser.

C. Cover Plates: Where cleanouts or test tees occur on concealed pipes in finished rooms, they shall be provided with a 0.11” (3mm) thick, machine finished, brass cover plate of sufficient diameter to cover the opening in the finished wall or partition. The cleanout plug shall have a solid head, tapped for a .25” (6mm) brass screw to secure the cover plate. Where cleanout plugs extend beyond the wall finish, the cover plates shall be of machine finished brass and shall be only of sufficient depth to fit against the wall to cover plug. Cleanout cover plates shall be painted to match adjacent wall finish.

D. Cleanouts Plugs For Threaded Fittings: Cleanout plugs for threaded fittings shall be in accordance with ANSI B16.12. Except for test openings, where size must be sufficient to admit

test plug, bushings will be permitted on pipes 5" (125mm) and larger to reduce plug size to 4" (100mm); cleanout plugs for piping 4" (100mm) and smaller shall be the same size as the pipe.

E. Cleanout Plugs For Hub-and-Spigot Fittings: Cleanout plugs for hub-and-spigot fittings shall be screwed into ferrules caulked into the fitting. Ferrules and plugs shall be in accordance with ANSI B16.12, except that plugs required to be flush with the floor shall have square countersunk heads in lieu of raised heads.

F. Cleanout Plugs For Copper Drainage Lines: Cleanout plugs on copper drainage lines shall be installed in solder-joint fittings having threaded openings provided for the cleanout, or in solder-joint fittings with threaded adapters.

3.5 WATER PIPING INSTALLATION

A. General: Water piping shall be complete from service connection to all fixtures and equipment outlets. Sizes of pipes shall be as shown or specified.

B. Reaming: Ends of pipes and tubes shall be reamed before being made up.

C. Threaded Joints: Threaded joints shall be made up metal-to-metal, with a noncorrosive lubricant applied to the male thread only. Lampwick or other packing material shall not be used in making up threaded joints.

D. Chromium Plated Piping: Chromium plated piping shall be threaded and made up carefully, and not more than one full turn of thread shall be exposed beyond any fittings.

E. Long Screws and Bushings: Long screws and bushings (other than bushings cast in the sand) shall not be used on water piping.

F. Soldering: Ends of tubing and recesses of fittings to be soldered shall be thoroughly cleaned. Joints shall be assembled without binding. Solder shall penetrate fully and shall fill the joint completely. Joints shall be made using lead-free solder, as specified.

G. Joint Materials: All joint materials shall be free from oil, tar, and greasy substances, and shall be dry when placed in the joint. The material shall be handled with care to prevent contamination.

H. Copper Tubing: All copper tubing shall be free from cuts, dents or other surface damage at the time of final inspection. Damaged tubing shall be removed and replaced with new.

I. Copper Tube Anchoring: Horizontal runs of copper tubing over 50ft (15m) in length shall be anchored to wall or floor construction. Anchors shall be located near the midpoints of the runs so as to force the expansion equally to the ends or in a direction where expansion can take place without excessive strain.

J. Swing Joints, Offsets, and Expansion Joints: Swing joints, offsets, and expansion joints shall be provided where necessary to accommodate expansion of piping, which will be approximately 0.05 (1.5mm) in 40" (1000mm) of copper hot water piping.

K. Dielectric Couplings: Where non-ferrous metal piping and zinc-coated metal piping are joined, dielectric (insulating) couplings, fittings or unions shall be provided.

L. Reducing Fittings: Where pipe sizes shown or specified differ from the connection sizes of meters, pumps, fixtures, outlets, and the like, reducing fittings shall be installed close to them.

M. Pipe Branches: Branches from water supply mains shall be taken from the top, bottom or side, using crossover fittings where required by structural or operating conditions.

N. Upfeed Hot Water Return: On upfeed hot water distribution systems for which return circulation piping is shown, a ½" (13mm) circulation connection shall be made at a point on each riser just below the highest outlet connection. Provide branch circulation lines with gate valves near the valves on corresponding supply lines.

O. Downfeed Hot Water Supply: Each downfeed main for a hot water supply system shall be graded upward to the first branch connection, which shall be taken from the top of the main. Beyond the first connection the main shall grade downward, and all branch connections shall be taken from the bottom of the main. Connect a 10.11" (3mm) circulating line to the bottom of each downfeed riser. Provide branch circuiting lines with gate valves in locations corresponding to the supply branch valve locations.

P. Grading: Hot water supply and hot water circulating lines shall be accurately and uniformly graded to avoid traps which might impede or destroy circulation. All lines shall be graded so as to facilitate drainage.

Q. Unions: Unions shall be installed near points of connection to each piece of equipment, and elsewhere as required for installation of piping, removal and replacement of regulating and control equipment and the like. Right and left couplings or nipples are prohibited.

R. Water Hammer Arresters: Water hammer arresters shall be provided where indicated on the drawings. Water hammer arresters shall be approved and installed in accordance with the requirements of PDI-WH201 and shall bear the PDI seal of approval.

S. Roughing: Roughing shall be provided for equipment furnished under other sections of the specifications. Where future extensions are indicated on the drawings, roughing shall extend to within the space to be served, and shall be valved, and capped or plugged.

3.6 INSTALLATION OF PRESSURE REDUCING VALVES

A. General: Install one or more pressure reducing valves on the main water line supplying plumbing fixtures.

1. The total capacity of each assembly shall be not less than the capacity specified.

2. Provide each pressure reducing valve with a gate valve and union on both the inlet and outlet connections.

3. A bypass one pipe size smaller than the main water line provided with a globe valve and union, shall be installed between the inlet and outlet sides of the pressure reducing valve assembly.

4. Pressure gauges shall be installed at the inlet and outlet connections to the pressure reducing valve assembly. Gauges shall have T-handle stops in their connections.

3.7 STRAINER INSTALLATION

A. General: Place strainers ahead of pressure reducing valves, automatic control valves, pumps, and elsewhere as indicated on the drawings or specified.

3.8 INSTALLATION OF PIPE SLEEVES

B. Basic Requirements: Install pipe sleeves as follows:

1. Pipe sleeves shall be provided for all pipes passing through walls, slabs on grade and floors. Sleeves may be omitted where pipes pass through exterior walls above ground to lawn faucets, wall hydrants and downspout nozzles.

2. Sleeves for pipes passing through exterior walls and slabs on grade which do not have membrane waterproofing shall be of cast-iron or galvanized steel pipe or black steel pipe, Schedule 40.

3. Sleeves for pipes passing through exterior walls, slabs on grade and floors which are provided with membrane waterproofing shall be of threaded galvanized steel pipe fitted with companion flanges and arranged to secure membrane. Companion flanges shall be drilled and tapped in such a manner that bolting is effected from the outer (or upper) face only.

4. Sleeves for pipes passing through potentially wet floors that do not have membrane waterproofing such as in toilet rooms, cafeteria kitchens, serving areas, dishwashing rooms, utility cores, mechanical equipment rooms, and areas that are provided with fire protection sprinkler systems, shall be galvanized steel pipe, shall project 2” (50mm) above the finished floors, and shall be caulked watertight.

5. Sleeves for pipes passing through all other floors and walls shall be constructed of galvanized or black steel pipe, standard weight.

C. Sleeves On New Work: On new work, sleeves shall be built into the walls and floors as the work progresses.

D. Sleeves For Exterior Walls Below Grade: Sleeves through exterior walls below grade shall be not less than 2” (50mm) greater in inside diameter than the outside diameter of the pipe it serves; all other sleeves shall be large enough to provide approximately 0.23”(6mm) clear annular space between the sleeve and pipe or between the sleeve and insulation where insulation is required. Except as specified for wet area floors, sleeves shall be of sufficient length to terminate flush with the finished floor or wall.

E. Caulking and Sealing: Spaces between pipes and sleeves passing through exterior walls, slabs on grade and over crawl spaces, and waterproofed floors shall be caulked watertight. Spaces between pipes and sleeves passing through floors, walls and ceilings of machine spaces, such as mechanical equipment, refrigeration, boiler, pump, fan, and machinery rooms, shall be packed and sealed at both ends of sleeve to provide a tight acoustical barrier.

F. Wall and Floor Plates: Uninsulated, exposed pipes shall be provided with plates at the points where they pass through floors, finished walls, and finished ceilings, including points where

covering is terminated 70”(1800mm) above the floor, Where necessary to cover beads of fittings, special deep escutcheons shall be provided in lieu of plates. Plates shall be not less than 0.01” (0.5mm) thick. Plates on chromium plated pipe or tubing shall be brass, chromium plated, with bright or polished finish. Wall and ceiling plates shall be secured with round head set screws, not with spring clips. Plates generally shall be of the one-piece type.

3.9 INSPECTION AND TESTS

A. Vitrified Clay and Concrete Pipe: Vitrified clay and concrete drainage piping shall not be pressure-tested but shall be inspected for tightness and proper bedding in the trench. No vitrified clay or concrete pipe shall be concealed, by backfilling or otherwise, until such inspection has been made and the installation approved.

B. Hydrostatic Testing of Underground Drainage Piping: Before final connections are made to public sewers or vitrified clay or concrete drainage pipes, and prior to backfilling of trenches or connecting of fixtures, all underground drainage piping unless otherwise specified shall be hydrostatically tested. All openings shall be capped or plugged and the system filled with water to the top of a vertical section of pipe 10 feet (3.05M) high, temporarily connected to the highest point of the underground system. The water shall be allowed to stand in the system for at least 1 hour prior to inspection. If the water level remains constant and no leaks are found during the period of inspection, the water shall be drained from the system. Final connections shall then be made to the public sewer or vitrified clay or concrete drainage pipes, and the trenches backfilled.

C. Hydrostatic Testing of Above Ground Vent and Drainage Piping: Before any fixtures are connected, all sanitary drain and vent systems, and storm drainage systems above ground, shall be hydrostatically tested. All openings shall be capped or plugged and the systems filled with water. The water shall be allowed to stand in the systems for at least 1 hour prior to inspection. If the water level remains constant and no leaks are found during the period of inspection, the water shall be drawn off and fixtures and the like connected. No parts of a system shall be tested with less than a 10 feet (3.05M) head of water. No parts of a system using cast-iron bell-and-spigot shall be tested with more than a 12 m head of water, and no parts of a system using screwed piping shall be tested with more than a 196 feet (50.75M) head of water. The Contractor shall be responsible for determining the amount of piping he wishes to test at one time, but the above conditions shall not be exceeded.

D. Hydrostatic Testing of Underground Water Piping: Before final connections are made to a water supply system and prior to backfilling, all underground water piping shall be hydrostatically tested and proven tight at a pressure of not less than 102psi (700kPa) or 50psi (350kPa) in excess of the working pressure, whichever is greater, at the lowest point in the system. The pressure shall be maintained for at least one hour for inspection. If the pressure remains constant and no leaks are found during the period of inspection, the water shall be drained from the system. Final connections shall then be made to the water supply system, and the trenches backfilled.

E. Hydrostatic Testing of Above Ground Water Piping: Before any fixtures are connected, all domestic water systems connected to them above ground shall be hydrostatically tested and proven tight at a pressure of not less than 102psi (700kPa) or 50psi (350kPa) in excess of the working pressure, whichever is greater, at the lowest point in the system. The pressure shall be maintained for at least 2 hours for inspection, the water shall be drained from the systems and final connections shall then be made to the fixtures.

F. Smoke or Peppermint Test: After all fixtures have been permanently connected and all traps filled with water, the entire sanitary drain and vent systems shall be tested with smoke or peppermint. Where the smoke test is preferred, a pungent thick smoke shall be introduced into the system by the use of one or more smoke producing machines. The smoke shall not be produced by chemical mixtures. When the smoke appears at the stack openings on the roof, they shall be closed and a pressure equivalent to 36psi (250kPa) shall be built up and maintained for 15 minutes before inspection starts. The entire system shall then be inspected for detection of smoke or smoke odors. Where the peppermint test is preferred, 0.013 gallons (50mL) of oil of peppermint shall be introduced into each stack. System shall then be closed and inspection shall be made in the same manner as specified for the smoke test.

G. Testing Sequence: All tests shall be made when there is no danger of freezing, prior to enclosure of any parts of the system by furrings, suspended ceilings or other finishes, and prior to the applications of insulation to any joints at fittings, valves, couplings and the like.

H. Future Stories: Where future stories are proposed for a building, the water piping systems shall be tested to reflect the added static pressure imposed by the added height.

I. Equipment Testing: Tests to demonstrate the capacities and general operating characteristics of all equipment, such as water heating outfits, pumps, water coolers and the like, shall meet the requirements of Section 01650, "Start-Up/Commissioning." Water heaters having steam or water coils shall be tested with the main heating system in operation.

J. Testing in Stages: Where conditions, building schedules, or occupancy schedules are such as to require the systems to be tested in sections, such tests shall be performed without additional cost.

K. Tests shall be performed as required by Section 01650, "Start-Up/Commissioning."

L. Corrections and Retests: Should any leaks, flaws, or defective materials or equipment be found during the testing operations, such leaks or flaws shall be corrected, and defective materials and equipment replaced. All defective joints shall be remade and caulking of threaded joints will not be acceptable. After corrections have been made, tests shall be repeated until all systems are proven tight and satisfactory. All corrections and retests shall be made without additional cost.

3.10 DISINFECTION OF WATER SYSTEMS

A. General: After completion of all tests and repairs, all new water supply systems, extensions to, and repaired sections of existing systems shall be thoroughly flushed with water to remove sediment and then disinfected. The disinfection shall be applied to all hot and cold water piping, drinking water piping, pumps, tanks and other piping and equipment connected downstream from the main cutoff valve.

B. Disinfectant: The disinfectant shall be chlorine, either in the form of a hypochlorite solution or in the form of compressed gas applied through an approved chlorinator. During chlorination, all valves and equipment shall be operated, to ensure that chlorine reaches all parts of the system. Water and chlorination agent shall be fed into the system at rates that will provide a residual chlorine content of not less than 10ppm after a retention period of 24 hours. (An initial application of 25ppm or more will generally be required.) In cases of piping system repair or other emergency, a residual chlorine content of 100ppm after a retention period of one hour, shall be provided in lieu of the content and retention time specified above.

C. Flushing: Following disinfection, all treated water shall be flushed from the system through its extremities. Flushing shall continue until samples show that the quality of the water delivered is comparable with the quality of the public water supply and satisfactory to the public health authority having jurisdiction. Flushing shall be repeated if samples taken daily over a period of three days show the water quality is not being maintained. Samples shall be taken only from taps located and installed in such a manner that they will not contribute any contamination. Samples shall not be drawn from hydrants or through unsterilized hose. Test samples shall be certified by a recognized and approved testing laboratory, and a certificate of acceptability shall be submitted.

END OF SECTION 15410

SECTION 15440 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Extent of plumbing fixture work required by this Section is indicated on the drawings and schedules, and by the requirements of this Section and Section 15010, "Mechanical Basic Requirements."

B. Types: Types of plumbing fixtures specified in this Section include:

1. Water closet
2. Lavatory
3. Urinal
4. Service sink
5. Fixture support
6. Electric water cooler

C. Related Sections: Refer to other Division 15 sections for the following:

1. Plumbing Piping Systems and Plumbing Specialties.

1.2 QUALITY ASSURANCE

A. Manufacturer: Provide all plumbing fixtures for this project that are the product of one manufacturer. The term "manufacturer" as used in this paragraph means a company with an established reputation in the manufacture and/or assembly of plumbing outfits from products of its own manufacture or others and that assumes responsibility for products in outfits not of its own manufacture.

B. Codes and Standards: Provide plumbing fixtures complying with the following codes and standards:

1. Air-Conditioning Refrigeration Institute (ARI): Provide electric water coolers that conform to ARI 1010, "Standard For Drinking-Fountain and Self-Contained Mechanically-Refrigerated Drinking-Water Coolers."

2. American National Standards Institute (ANSI):

a. A112.6.1M Supports for the Off-The-Floor Plumbing Fixtures for Public Use

b. A112.18.1M Finished and Rough Brass Plumbing Fixture Fittings

c. A112.19.1M Enameled Cast Iron Plumbing Fixtures

d. A112.19.2M Vitreous China Plumbing Fixtures

e. A112.19.3M Stainless Steel Plumbing Fixtures (Designed for Residential Use)

f. A112.19.5 Trim for Water-Closet Bowls, Tanks, and Urinals (Dimensional Standards)

g. Z358.1 Emergency Eyewash and Shower Equipment

3. Federal: Construct and install barrier-free plumbing fixtures in accordance with Uniform Federal Accessibility Standards U.S. Government Printing Office - 1985-494-187.

4. National Association of HomeBuilders (NAHB): Provide fiberglass bath tub units and shower stalls which have been tested and labeled by the NAHB National Research Center.

5. National Association of Plumbing-Heating-Cooling Contractors (NAPHCC): Comply with applicable portions of the "National Standard Plumbing Code," pertaining to materials and installation of plumbing fixtures.

6. Plumbing and Drainage Institute (PDI): Comply with standards established by the PDI pertaining to plumbing fixture supports.

7. Public Law 90-480: Comply with Public Law 90-480, known as the Architectural Barriers Act of 1968.

1.3 SUBMITTALS

A. Division 1: Conform to the requirements of Division 1, Section 01003, "Submittals."

B. Product Data: Submit manufacturer's technical product data, including rated capacities of selected models clearly indicated, furnished specialties and accessories, and installation instructions.

C. Shop Drawings: Submit manufacturers shop drawings indicating dimensions, roughing-in requirements, and required clearances.

D. Maintenance Data: Submit maintenance data and parts list for each type of plumbing fixture and accessories.

1.4 DELIVERY, STORAGE AND HANDLING

A. Delivery: Deliver plumbing fixtures individually wrapped in factory-fabricated containers.

B. Handling: Handle plumbing fixtures carefully to prevent breakage, chipping and scoring of the fixture finish. Do not install damaged plumbing fixtures; replace with new.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (Not Used)

2.2 PLUMBING FIXTURES, GENERAL

A. General: Unless otherwise specified, provide fixtures, fittings, trimmings, metals, and finishes in accordance with the applicable ANSI publication.

2.3 WATER CLOSETS

A. Flushometer Type Water Closets (P-2): ANSI A112.19.2M, white vitreous china wall-mounted, wall outlet, siphon jet, elongated bowl with white, solid, plastic, elongated open-front seat, and ANSI A112.19.5 trim. Provide large (not less than 3" (80mm) in diameter) diaphragm non-hold-open flushometer including vacuum breaker and angle (control-stop) valve mounted approximately 3.28'(1M) above floor. The water flushing volume of the flushometer and water closet combination shall not exceed 3 gallons (15L) per flush; water closet manufacturer shall furnish certification of compliance. Provide ANSI A112.6.1M carrier with feet.

1. Flush valve shall be capable of operation without chattering or water hammer, at any inlet pressure from 15psi (100kPa) to 50psi (350kPa).

2. Handle of flush valve shall be chromium-plated copper alloy.

3. Stop valve shall be straight or angle type as required to suit flush valve.

4. China or plastic caps or chromium-plated bowl nuts shall be provided.

B. Wheelchair Water Closets (P-1): Provide same as specified for water closets (P-2) except water closet rim height shall be 18" (450mm) above floor.

2.4 LAVATORIES

A. Lavatories for Wheelchairs (P-5): ANSI A112.19.1M, white enameled cast-iron or ANSI A112.19.2M white vitreous china with ANSI A112.6.1M concealed arm carrier support, straight back type, minimum dimensions of 18" (480mm) wide by 16" (400mm) front to rear, 29" (735 mm) minimum clearance from bottom of front rim to floor, 34"(865mm) front rim height above floor. Provide ANSI A112.18.1M copper alloy center-set faucets, gooseneck spout with aerator 5" (125mm) above rim, 4" (100mm) wrist action handles, perforated grid strainers with offset tailpiece, and 11/2" (40mm) adjustable P-trap. Faucets with wrist action handles shall open within one-quarter turn in opposite directions. Provide ANSI A112.6.1M concealed chair carriers.

2.5 URINALS

A. Flushometer Type Urinals (P-3): ANSI A112.19.2, white vitreous china, wall-mounted outlet, siphon jet, integral trap, extended side shields, and ANSI A112.19.5 trim. Provide large (not less than 3"(75 mm) in diameter) diaphragm non-hold-open flushometer including vacuum breaker and angle (control-stop) valve. The water flushing volume of the flushometer and urinal combination shall not exceed 1-gallon (3.8 L) per flush; urinal manufacturer shall furnish certification of compliance. Provide ANSI A112.6.1M concealed chair carriers.

B. Urinals for Physically Handicapped (P-4): Provide wall hung projecting flush valve urinals for use by physically handicapped in accordance with ANSI A112.19.2M Figure 29 or 31. Provide flush valve of the pushbutton solenoid or proximity type.

2.6 SERVICE SINKS

A. Service Sink (P-7): ANSI A112.19.1M, white enameled cast-iron, wall mounted and floor supported by wall outlet cast-iron P-trap, minimum dimensions of 24" (610mm) wide by 20" (510mm) front to rear with 9" (230mm) splashback, and stainless steel rim guard. Provide ANSI A112.18.1M copper alloy back-mounted combination faucets with vacuum breaker and ¾" (20mm) external hose threads.

2.7 ELECTRIC WATER COOLERS

A. Electric Water Cooler (P-6): ARI 1010, one piece in wall-mounted, two bubble style bilevel, air-cooled condensing unit 9GPH of 50°F of water, 18L/hr minimum capacity, stainless steel splash receptor, and all stainless steel cabinet. Cooler shall comply with ANSI 117:1 bubblers shall be controlled by push levers or by push bars.

B. Manufacturer Submittal: Provide a letter from the manufacturer attesting that lead based solders were not used in the fabrication of the cooler.

2.8 FIXTURE SUPPORTS

A. Water Closet Support: Provide water closet chair carrier and fitting consisting of a sanitary drainage fitting, cast-iron vertical support member made either separate or integral with the drainage fitting horizontally adjustable cast-iron inlet sleeve and furnished with necessary gaskets, support rods, fastening bolts, nuts, washers and chrome plated trim.

1. The carrier and fitting shall support the fixture from floor by means of one or more feet bolted to or imbedded into the floor.

2. Combination carrier and fitting shall be vertically adjustable and shall support fixture in such a manner that no part of fixture will be supported by wall or partition.

B. Urinal Support: Provide urinal chair carriers consisting of a pair of cast-iron feet bolted to or imbedded into the floor together with 1.6" (42mm) outside diameter (minimum), steel tubular upright members, steel hanger support plate, and steel bearing plate connected to cast iron or steel adjustment sleeves and furnished with necessary bolts, nuts, washers, and chrome plated trim. Provide chair carrier that is fully concealed in the building construction and that supports the fixture in such a manner that no part of the fixture will be supported by the wall or the partition.

C. Lavatory Support: Provide lavatory chair carriers consisting of a pair of cast-iron feet bolted to or imbedded into the floor together with 1.6" (42mm) (minimum) steel tubular upright members, a horizontally adjustable alignment truss or tie rod at bottom and another at the top connected to cast-iron or steel adjustment sleeves and painted cast-iron or steel adjustment sleeves, and painted cast-iron concealed arms.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. General: Provide the correct number of fixtures and roughings as indicated on the drawings. Where "future" fixtures are shown or specified, install roughings and plug pipes gastight and watertight.

3.2 WATER CLOSET INSTALLATION

A. General: Install water closets as shown on the drawing and as follows:

1. Supply pipe extending from wall shall be covered by chrome plated sleeve and wall flange.

2. Additional wall plates shall be provided where each pipe extends through finished wall.

3. Two rubber or plastic seat bumpers with metal holders shall be provided and secured to the wainscot behind the fixture.
4. The centerline of the flush valve shall be on the centerline of the fixture, 39” (1000mm) above the finished floor and a minimum of 2 ½” (60mm) from the wall.

5. Chrome plated pipe support shall be provided on the long flush pipe outlet and shall be secured rigidly to the wall with suitable anchors.

6. The backflow preventer for the flush valve shall be installed at the discharge of the valves.

7. The flush valve water piping concealed in the partition shall be rigidly supported; piping between flush valve and wall shall be provided with a factory fabricated chromium plated spacer sleeve and wall flange.

3.3 LAVATORY INSTALLATION

A. General: Install lavatories as shown on the drawings and as follows:

1. Lavatories for use by wheelchair handicapped shall be installed with a minimum rim height of 34”(865mm), a minimum vertical clearance of 29” (735mm) from floor, and a minimum clear knee recess of 30” (760mm) in width and 20” (500mm) in depth.

2. Trap on lavatory for use by wheelchair handicapped shall be installed so as to provide maximum clearance under bowl. Exposed waste, trap and hot water supply under lavatory shall be insulated in accordance with the requirements for domestic hot water piping.

3. All lavatories shall be installed with a rim height of 34” (860mm).

4. Each lavatory in public toilet rooms that does not have a soap dispenser recessed in the walls (specified under another section of this specification) shall be provided with a lather-type soap dispenser installed in the top fixture surface on the left or right hand side of the lavatory.

3.4 URINAL INSTALLATION

A. General: Install urinals as shown on the drawing and as follows:

1. Supply pipe extending from wall shall be covered by chrome plated sleeve and wall flange.

2. Additional wall plates shall be provided where each pipe extends through finished wall.

3. The centerline of the flush valve for wall hung urinals shall be on the centerline of the fixture, 45" (1140mm) above the finished floor and a minimum of 2" (55mm) from the wall.

4. The centerline of the flush valve for handicap urinals shall be 40" (1015mm) or less above the finished floor.

5. The backflow preventer for flush valve shall be installed at the discharge of the valve.

6. The flush valve and the water piping concealed in the partition shall be rigidly supported; piping between flush valve and wall shall be provided with a factory fabricated chromium-plated spacer sleeve and wall flange.

3.5 SHOWER INSTALLATION

A. General: Install shower fixtures as shown on the drawings. Shower enclosures are included in another section of the specification.

3.6 SERVICE SINK INSTALLATION

A. General: Install service sink as shown on the drawings and as follows:

1. Faucets shall be mounted on the wall above the sink back at such a height that the centerlines of the supplies will be 35" (900mm) to 45" (1150mm) above the finished floor and the faucets shall be centered over the receptor.

2. Pipe from drain fittings to traps shall be caulked into the drain fitting.

3. Supply and waste connections to service sinks shall be to wall or floor as required.

4. Exposed water supplies to service sinks in unfinished spaces shall be unfinished brass or copper.

3.7 ELECTRIC WATER COOLER INSTALLATION

A. General: Install as shown on the drawings and as follows:

1. Electrical water cooler shall be mounted so that the bubbler will be as required by ADA for wheelchair handicapped shall be mounted with a minimum rim height above the floor.

3.8 FIXTURE CONNECTIONS

A. Service Sinks: Provide connections between soil pipes and service sinks made with cast-iron flanges.

   1. Connection sizes shall be 3” (75mm) for service sinks.

   2. Special short radius fittings shall be used where space does not permit the use of standard fittings below the flanges.

B. Setting Compounds and Gaskets: Provide watertight and gas tight seals between flanges and fixtures with plumbing-fixture-setting compound complying with Federal Specification TT-P-1536, "Plumbing Fixture Setting Compound" or manufacturer's standard non-asbestos gaskets.

   1. Neither rubber gaskets nor putty shall be used in sealing connections.

   2. All voids between the flange and the floor below the fixture shall be sealed watertight with plumbing-fixture-setting compound or other approved sealing material.

C. Wall Hung Water Closet and Urinal Connections: Provide connections to wall hung water closets and urinals made with adjustable flanged nipples, secured to the chair supports, and non-asbestos gaskets.

D. Outlet Flanges and Ends of Soil Pipes: Provide outlet flanges and ends of soil pipes set the correct distance from the face of the floor or wall to make a joint with the gasket and fixture. Obtain approval for the setting of the flange prior to setting any fixture in place.

E. Water Supply Branch Piping: Provide all exposed water supply branch piping (including valves and fittings) not more than 70” (1,800mm) above the floor in toilet rooms and all piping below lavatories finished and chromium-plated.

   1. No water pipe shall be buried in floor construction of any toilet room.

   2. Where water piping is not sized on the drawings, it shall comply with the sizing requirements of the National Standard Plumbing Code.

   3. Each hot and cold water supply to each service sink, kitchen sink, engineers' sink, battery of lavatories, and pair of laundry trays shall be provided with a gate or angle valve or compression stop in an accessible location near the fixture.

   4. A gate valve shall be provided on the connection to each wall hydrant, lawn faucet, and water cooler.

   5. Stopcocks shall not be used in lieu of valves.

   6. Risers and drops supplying toilet rooms shall be run in chases, furred spaces, or shafts where possible.

3.9 FIXTURE SUPPORT INSTALLATION

A. Fixture Heights: Adjust chair supports so that the height of fixtures above the finished floor will be as follows:

1. Water Closet: 15”(380mm to 400mm) to top of earthenware.

2. Water Closet for Physically Handicapped Persons: 17” (430mm to 480mm) to top of seating surface.

3. Urinal: 24” (610mm) to top surface of lowest part of lip at front.

4. Urinal for Wheelchair: 15” to 17” (380mm to 430mm) to top surface of lowest part of lip at front.

5. Lavatory: 31” (790mm) to top of trim.

3.10 EXTRA WASHERS

A. General: Deliver one dozen complete sets of washers.

1. Each set shall contain one washer of each size and type used in the faucets, bibbs, ball cocks, closet tanks, flushing valves, mixing valves, and wall hydrants, installed in the project.

2. The washers shall be enclosed in a wood or metal box with hinged cover and a separate compartment for each size and type of washer.

3. If the manufacturer of the above items installed in a project regularly catalogs a metal box containing an assortment of replacement parts, a sufficient number of such boxes required to satisfy the above washer requirements may be furnished in lieu of the single box, subject to approval.

END OF SECTION 15440

SECTION 15510 - HYDRONIC PIPING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Extent of hydronic piping, fittings, valves and accessories is indicated on the drawings, in schedules and by the requirements of this Section, and Section 15010, "Mechanical Basic Requirements."

B. Types: Types of hydronic piping systems specified in this Section include the following:

1. Chilled water supply and return.

2. Heating water supply and return.

C. Related Sections: Refer to other Division 15 sections for the following:

1. Meters and Gauges.

2. Supports and Anchors.

3. Mechanical Identification.

4. Mechanical Insulation.

5. Firestopping.

6. Testing, Adjusting, and Balancing.

D. Other Divisions: Refer to other Divisions of the specification for the following:

1. Field Painting: Division 9.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Provide piping conforming to the requirements of the following:

1. American National Standards Institute (ANSI):

a. B16.1 Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800(170, 860, 1720 and 5500 kPa).

b. B16.4 Cast Iron Threaded Fittings Classes 125 and 250(860 and 1720 kPa)

c. B16.3 Malleable Iron Threaded Fittings

d. B16.5 Pipe Flanges and Flanged Fittings

e. B16.9 Factory-Made Wrought Steel Buttwelding Fittings

f. B16.11 Forged Steel Fittings, Socket-Welding and Threaded

g. B16.18 Cast Copper Alloy Solder Joint Pressure Fittings

h. B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

i. B16.39 Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300(1030, 1720, and 2070 kPa)

j. B31 Code for Pressure Piping

k. B31.1 Power Piping

2. American Society of Mechanical Engineers (ASME): Installation of piping shall conform to the requirements of ANSI B31.1 "Power Piping."

3. American Society for Testing and Materials (ASTM):

a. A 47 Standard Specification for Ferritic Malleable Iron Castings

b. A 53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded Seamless

c. A 106 Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service

d. A 126 Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings

e. A 183 Standard Specification for Carbon Steel Track Bolts and Nuts

f. A 193/ A 193M Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service

g. A 194/ A 194M Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service

h. A 216/ A 216M Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding for High-Temperature Service

i. A 276 Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes

j. A 307 Standard Specification for Carbon Steel Bolts and Studs, 60 000 psi(410,000 kPa) Tensile Strength

k. A 536 Standard Specifications for Ductile Iron Castings

l. B 16 Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines

m. B 32 Standard Specification for Solder Metal

n. B 61 Standard Specification for Steam or Valve Bronze Castings

o. B 62 Standard Specification for Composition Bronze or Ounce Metal Castings

p. B 88 Standard Specification for Seamless Copper Water Tube

4. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):

a. SP 67 Butterfly Valves

b. SP 70 Cast Iron Gate Valves, Flanged and Threaded Ends

c. SP 71 Cast Iron Swing Check Valves, Flanged and Threaded Ends

d. SP 72 Ball Valves with Flanged or Butt-Welding Ends for General Service

e. SP 80 Bronze Gate, Globe, Angle and Check Valves

f. SP 84 Steel Valves - Socket Welding and Threaded Ends

g. SP 85 Cast Iron Globe and Angle Valves Flanged and Threaded Ends

B. Qualification of Welders: Welders performing work under this Contract shall be certified and qualified in accordance with tests prescribed by the National Certified Welding Bureau (NCWB) or by other approved test procedures using methodology and procedures covered in the ASME Boiler and Pressure Vessel Code, Section IX, "Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators."

1. Submit for approval the names, identification, and welder's assigned number, letter or symbol of welders assigned to this project.

2. The assigned identification symbol shall be used to identify the work of each welder and shall be indelibly stamped immediately upon completion of each weld.

3. Welders shall be tested and certified for all positions.

4. Submit identifying stencilled test coupons made by each operator.

5. Any or all welders may be required to retake welding certification tests without additional expense.

6. When so requested, a welder shall not be permitted to work as a welder on this project until he has been recertified in accordance with NCWB.

7. Recertification of the welder shall be made after the welder has taken and passed the required tests.

8. Where piping 1-1/2 inches(40 mm) and smaller is butt or socket welded, submit 3 samples of test welds for approval.

1.3 SUBMITTALS

A. Division 1: Refer to Section 01003, "Submittals" for basic information relating to submittal requirements.

B. Product Data: Submit manufacturer's standard technical product data indicating conformance to the stipulated reference specifications, construction materials, construction details, and test and operating pressures. Submit manufacturer's product data on the following:

1. Pipe materials.
2. Unions and flanges.
3. Welding fittings.
4. Valves.
5. Strainers.

C. Shop Drawings: Provide piping layout drawings, drawn to a scale of not less than 1/4-inch(1:50) to one foot showing the proposed layout of piping systems including valves, fittings, equipment, pumps, hangers, grading, high points, low points, drain points, anchors, and expansion devices. Provide shop drawings for the following locations:

1. Refrigeration rooms.
2. Air handling equipment rooms.
3. Pipe shafts containing more than one pipe system.
4. Cooling coils.
5. Heating coils.
6. Refrigeration machines.
7. Heat exchangers.

1.4 STORAGE AND PROTECTION

A. Storage: Store piping on the project site so as to preclude the entrance of construction dirt and debris into the open ends of piping. Do not install piping fouled with construction dirt.

B. Storage of Fittings: Store fittings under cover, protected from construction dirt and rain.

C. Storage of Valves: Store valves under cover with blind or protective wood flanges secured to valve openings. Valves fouled with construction dirt shall be removed from the project site and replaced with new.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (Not Used)

2.2 PIPING MATERIALS

A. Pipe 2-1/2-inch(65 mm) Diameter and Smaller: Provide piping as follows:

1. Black steel, Schedule 40, conforming to ASTM A 53 or A 106.
2. Copper, Type K or L, conforming to ASTM B 88.

B. Pipe 3 inches(80 mm) Diameter and Larger: Provide piping as follows:

1. Schedule 40 black steel conforming ASTM A 53 or A 106.

2. Use A 53 or A 106 for expansion loops, expansion bends or stresses in excess of 12,000 psig.(82,700 kPa.)

2.3 PIPE FITTINGS: 125 PSIG(860 KPA) MAXIMUM WORKING PRESSURE

A. Fittings 2-inch (50 mm) and Smaller: Pipe fittings for piping 2 inches (50 mm) and smaller shall be tested and permanently stamped for 125 psig (860 kPa) water working pressure and conform to the following:

1. Provide threaded cast iron elbows, tees, caps and plugs conforming to ANSI B16.4, Class 125. (860 kPa).

2. Threaded galvanized malleable iron elbows, tees, plugs and caps conforming to ANSI B16.3, Class 150. (1030 kPa).

3. Provide cast iron flanges conforming to ANSI B16.1, Class 125. (860 kPa).

4. Provide galvanized malleable iron unions, with bronze facings conforming to ANSI B16.39.

5. Provide bolts and nuts conforming to ASTM A 307, Grade B up to 125 pounds per square inch (860 kPa) working pressure.

B. Fittings 2-1/2-inch (65 mm) Diameter and Larger: For working pressures not exceeding 125 psig (860 kPa) water pressure provide fittings as follows:

1. Provide butt-welding tees long radius pattern, long radius elbows and caps conforming to ANSI B16.9, each stamped by the manufacturer for conformance and working pressure.

2. Provide steel flanges conforming to ANSI B16.5, standard or welding neck pattern.

3. Provide cast iron flanged tees, flanged long radius elbows, flanged reducers and blank flanges conforming to ANSI B16.1, 125-psig (860 kPa) class.

C. Fittings for Copper Pipe: Provide fittings for copper piping 2-1/2-inch (65 mm) diameter and smaller as follows:

1. Provide cast or wrought copper solder joint fittings conforming to ANSI B16.18 or ANSI B16.22. Solder shall be composition ASTM B 32 Grade 95TA, Tin-Antimony or ASTM B 32 95TS Silver Solder.

2. The use of lead-tin solder is not permitted.

2.4 PIPE FITTINGS: 250 PSIG (1720 kPa) MAXIMUM WATER WORKING PRESSURE

A. Markings: Provide fittings with raised cast or permanently stamped identification by the manufacturer indicating 250 pounds per square inch (1720 kPa) water working pressure.

B. Fittings 2-inch (50 mm) and Smaller: Fittings 2 inch (50 mm) and smaller may be threaded, flanged or socket welded and shall conform to the following:

1. Provide threaded cast iron elbows, tees and caps conforming to ANSI B16.5, Class 250. (1720 kPa.)

2. Provide galvanized threaded malleable iron tees, long radius elbows, plugs and caps conforming to ANSI B16.3, Class 300. (2070 kPa.)

3. Provide flanges, threaded cast iron, conforming ANSI B16.1, Class 250. (1720 kPa.)

C. Fittings 2-1/2-inch (65 mm) and Larger: Provide fittings with cast raised or permanently stamped identification indicating conformance to the following:

1. Provide butt welding tees, long radius elbows, and caps conforming to ANSI B16.9, 300 pound (2070 kPa) class.

2. Provide steel flanges, long welding neck type, raised faces, conforming to ANSI B16.5, 300-pound (2070 kPa) class.

D. Bolts and Nuts: Provide bolts and nuts for working pressures above 125 pounds per square inch (860 kPa) as follows:

1. Provide bolts conforming to ASTM A 193/A 193M, Grade B7.

2. Provide nuts conforming to ASTM A 194/A 194M, Grade 7.

E. Studs: Where space does not permit installation of bolts, provide full threaded steel studs and nuts conforming to the following:

1. Provide studs conforming to the requirements of ASTM A 193/ A 193M, Grade B7 and nuts conforming to ASTM A 194/A194M, Grade 7.

F. Socket Welding Fittings: Provide socket welding fittings on piping 1-inch25 mm diameter and smaller conforming to the following:

1. Provide socket fittings in conformance with ANSI B16.11.

2.5 SHAPED NIPPLES

A. Welded Shaped Nipples: On hydronic piping systems operating at less than 125 pounds per square inch (860 kPa) water working pressure, factory made shaped welding nipples may be used under the following conditions:

1. Thickness of the fitting at any point shall not be less than the thickness of adjacent piping.

2. Tapping holes shall be drilled or ground smooth and of a diameter to match nipple bell.

3. Branch pipe diameter does not exceed 50 percent of the diameter of the main.

4. Field cut pipe or standard threaded coupling will not be permitted.

2.6 GROOVED PIPE FITTINGS (MECHANICAL COUPLINGS)

A. General: On systems operating at less than 125 pounds per square inch (860 kPa) maximum water working pressure and 210F (100C) degrees temperature, grooved mechanical fittings may be furnished in lieu of welded, flanged or screwed pipe connections.

1. Provide self-centering couplings, elbows and tees which shall engage and lock in place the grooved or shouldered pipe and fitting ends in a positive watertight joint.

2. Provide fittings capable of not less than 5 degrees center line deflection without leakage.

3. Castings shall be malleable iron complying with ASTM A 47 or ductile iron conforming to ASTM A 536. Gaskets shall conform to ASTM D 2000, Grade E, EPDM elastomer.

4. Provide not less than 2 square, track head or oval neck steel bolts, heat-treated carbon steel in conformance with ASTM A 183.

5. Elbows, tees, and coupling bodies shall be grooved, or shouldered and constructed of malleable iron castings conforming to ASTM A 47 or ductile iron Grade 60-45-10 in accordance with ASTM A 536.

6. Pipe grooving shall be performed in accordance with manufacturers' specifications for pipe sizes 3/4-inch through 24-inch diameter.

7. Flanged fittings and flanged or threaded end valves shall be connected to the grooved pipe system with grooved adapters.

B. Vibration: Provide connection points of grooved piping to air compressors, reciprocating refrigeration machines, and other equipment subject to vibration with 316 stainless steel braided wire-covered stainless steel corrugated flexible connections of length not less than 4 pipe diameters. Pressure ratings of flexible connections shall be not less than 150-pound (1030 kPa class).

2.7 CONNECTION POINTS TO EQUIPMENT

A. Pipe connection points to mechanical equipment shall be one of the following types, unless otherwise indicated:

1. Unions. Unions may only be used for pipe sizes 2 inch (50 mm) and smaller and only in systems not exceeding 860-kPa water working pressure. Unions shall be as herein before specified under Article "Pipe fittings: 125 psig (860 kPa) Maximum."

2. Mechanical couplings. Couplings may only be used for pipe sizes 3” (75 mm)and smaller in conformance to conditions and materials specified above under Article "Grooved Pipe Fittings."

3. Flanges. Flanges may be used in any pipe size and shall be used in pipe sizes 3”(75mm) and larger. Flanges shall be as herein before specified, depending on service (i.e. generally ANSI B16.1 or B16.5 with Class depending on service).

2.8 FLEXIBLE PIPE CONNECTIONS

A. Unless otherwise specified, flexible pipe connections shall be stainless steel corrugated pipe covered with 316 stainless steel braided wire, of length not less than 4 pipe diameters. Pressure ratings of flexible connections shall be suitable to the service intended and in any case shall be not less than 1030 kPa class.

B. Locations: Flexible connections shall be provided for connection points to Air Handling units, VAV reheat coils, and all other equipment subject to vibration.

2.9 VALVES: MAXIMUM 125 PSIG (860 KPA) SYSTEM WORKING WATER PRESSURE

A. Valves 1-1/2-Inch (40 mm) and Smaller: On systems not exceeding 125 psig (860 kPa) water working pressure and 250F (120C) degrees temperature, provide valves conforming to the following:

1. Construct valves of ASTM B 62 bronze in conformance with MSS SP 80, Class 125 pounds. (860 kPa).

2. Ends may be threaded or solder connection type.

3. Valves shall be gate, globe, or check valves as indicated on the drawings.

B. Gate, Globe and Check Valves 2-Inch (50 mm) Through 3-Inch (75 mm) Diameter: Provide gate, globe and check valves conforming to the following:

1. Provide valves with bronze or cast iron bodies.

2. Bronze body valves shall conform to the requirements of valves 1-1/2-inch (40 mm) and smaller.

3. Cast iron body valves shall conform to the requirements of valves 4 inches (100 mm) and larger.

C. Gate and Globe Valves 4 Inches (100 mm) and Larger: Provide gate, globe and check valves rated for 125 psig (860 kPa) water working pressure and 250F (120C) degrees temperature. Conform to the following:

1. Gate valves shall be cast iron or steel conforming to MSS SP 70, OS&Y rising stem pattern, with bronze seats, solid wedge disc, bronze stem and flanged end connections.

2. Globe valves shall be cast iron or cast steel conforming to MSS SP 85, rising stem pattern with bronze seats replaceable Teflon plug facing, bronze stem, and flanged end connections.

D. Handwheels: Provide handwheels of ductile iron, malleable iron or steel.

E. Check Valves, Swing Pattern: Provide swing pattern type check valves conforming to the requirements of MSS SP 71 and as follows:

1. Body shall be cast iron with flanged end connections, bronze disc holder, resilient disc, bronze seats, cast iron flanged cap and resilient gasket.

F. Ball Valves 1-1/2-inch (40 mm) and Smaller: On systems not exceeding 125 psig (860 kPa) water working pressure and 250F (120C) degrees temperature, ball valves may be used in lieu of gate valves. Conform to the following:

1. Construct valves in conformance with MSS SP 84, with carbon steel bodies, virgin Teflon seal rings, chrome plated carbon steel ball, bolted or top entry construction with threaded ends.

G. Ball Valves 1/2-inch (13 mm) Diameter and Smaller: Ball valves may be used in runouts to terminal units for heating and cooling applications. Valve shall be rated for 125 pounds per square inch (860 kPa) water working pressure and shall conform to the following:

1. Bodies shall be cast bronze conforming to ASTM B 62.

2. Ball shall be brass ASTM B 16 Alloy 360.

3. Handle shall be steel, zinc plated, with vinyl handle cover.

4. Stems shall be brass ASTM B 16 Alloy 360.

5. Ends may be threaded, soldered or compression type.

H. Ball Valves 2-inch (50 mm)and Larger: On systems operating at 125 pounds per square inch (860 kPa) maximum working water pressure and 250F (120C) degrees temperature. Ball valves conforming to the following shall be provided.

1. Construct valves in conformance with MSS SP 72, Class 150. (1030 kPa).

2. Ends shall be flanged.

3. Bodies shall be carbon steel ASTM A 216/A 216M.

4. Ball shall be stainless steel conforming to ASTM A 276-304 on sizes 4-inch (100 mm) and smaller, and chrome plated carbon steel ASTM A 216/A 216M on valve sizes 6 through 12-inch. (150 mm through 300 mm).

5. Stems shall be stainless steel ASTM A 276-316.

6. Glands shall be stainless steel, with stainless steel studs and nuts.

7. Provide manual gear operators on valves 2 inches (50 mm) and larger, sized by the manufacturer, containing oil lubricated milled steel gears and steel or cast iron housing with bolted accessible maintenance plates, cast steel hand cranks or semi- steel gear wheels.

2.10 VALVES: MAXIMUM 250 PSIG (1720 KPA) SYSTEM WORKING WATER PRESSURE

A. Valves 1-1/2-Inch (40 mm) and Smaller: On systems not exceeding 250 psig (1720 kPa) water working pressure and 250F (120C) degrees working temperature provide valves conforming to the following:

1. Construct valves of ASTM B 61 bronze in conformance with MSS SP 80, Class 200. (1400 kPa).

2. End connections shall be threaded.

3. Valves shall be gate, globe or check valves as indicated on the drawings.

B. Gate, Globe and Check Valves 2-Inch (50 mm) Through 3-Inch (75 mm) Diameter: Provide gate, globe and check valves conforming to the following:

1. Provide valves with bronze or cast iron bodies.

2. Bronze bodies shall conform to the requirements of valves 1-1/2-inch (40 mm) and smaller.

3. Cast iron bodies shall conform to the requirements of valves 4-inch (100 mm) and larger.

C. Gate and Globe Valves 4 Inches (100 mm) and Larger: Provide gate and globe valves on systems with maximum 250 psig (1720 kPa) water working pressure and maximum 250F (120C) degrees temperature conforming to the following:

1. Gate valves shall be cast iron or steel conforming to MSS SP 70, Class 250, (1720 kPa), OS&Y rising stem pattern, with bronze seats, solid wedge discs, bronze stems and flanged end connections.

2. Globe valves shall be cast iron or cast steel conforming to MSS SP 85, Class 250, (1720 kPa), rising stem pattern with bronze seats, replacement Teflon plug facings, bronze stem and flanged end connections.

D. Handwheels: Provide handwheels of ductile iron, malleable iron or steel.

E. Glands: Glands shall be brass or bronze.

F. Bolting: Bolts and studs connecting pressure containing parts shall have developed physical strength not less than the requirements of ASTM A 307, Grade B.

G. Check Valves Swing Pattern: Provide swing pattern check valves conforming to the requirements of MSS SP 71, Class 250 (1720 kPa) and as follows:

1. Body shall be cast iron with flanged end connections, bronze disc holder, resilient disc, bronze seats, cast iron flanged cap and resilient gasket.

2.11 BYPASSES

A. Valves 12-Inch (300 mm) Diameter and Larger: Provide bypasses in all valves 12-inch (300 mm) diameter and larger. Bypass valves shall be sized by the manufacturer, not less than l-inch (25 mm) in size and of 300-pound (2070 kPa) water working pressure.

1. On systems with an operating pressure greater than 30 pounds per square inch, (200 kPa), bypasses shall be of the 3-valve type, with two shut-off valves and a plugged drain valve.

B. Valves 6-Inch (150 mm) Diameter and Larger: On systems with an operating pressure in excess of 125 pounds per square inch,(860 kPa), provide 3-valve bypasses for valves 6-inch (150 mm) diameter and larger.

1. 3-valve bypasses shall consist of two threaded shut-off valves and a plugged drain valve.

2. Select bypass valves for 300-pound (2070 kPa) working water pressure.

2.12 NON-SLAMMING OR SPRING LOADED CHECK VALVES

A. Types: Provide valves of the fully guided or cone-and-diaphragm types.

B. Bodies: Provide flanged or wafer type bodies constructed of cast iron ASTM A 126, Class B; cast steel ASTM A 216/A 216M, Class WCB; stainless steel, Type 304 or cast bronze ASTM B 61.

C. Trim: Seats, discs and springs shall be constructed of 18-8 stainless steel or bronze complying with ASTM B 62. Seats may be of elastomers suitable for 250120 degrees F.C minimum continuous working temperature or not less than 50F (10C) degrees above the operating temperature of the system, whichever is higher.

D. Mating Surfaces: Mating surfaces of closure faces shall be bronze or Type 316 or 17-4PH stainless steel or elastomer approved for the particular service and materials must be compatible to prevent electrolytic action.

E. Pressure Loss: Pressure loss through the valves, measured in feet of water, (kPa), shall not exceed 6/10 of the water velocity in feet per second (meter/second).

F. Bubble-Tight: Non-slamming and spring loaded check valves shall provide bubble-tight shut-off when handling water up to 250F (120C) degrees and 125 pounds per square inch (860 kPa) differential pressure. Design shall prevent rubbing of seat materials when opening and closing. Poppet valves shall have conical springs.

2.13 STRAINERS

A. Types: Provide strainers of the "Y" or basket types as indicated on the drawings or required to suit the field conditions.

B. Strainers 1-1/2-Inch (40 mm) Diameter and Smaller: Provide strainers with bronze bodies conforming to ASTM B 62, Grade C or cast iron bodies conforming to ASTM A 126, Class B.

1. End connections shall be threaded.

2. Screens shall be 18-8 stainless steel with 1/32-inch (0.80 mm) diameter perforations or openings.

C. Strainers 2-Inch (50 mm) and Larger: Provide strainers with cast iron bodies conforming ASTM

A 126, Class B with flanged end connections.

1. Screens shall be bronze, monel metal or 18-8 stainless steel.

2. Sizes 2-inch to 6-inch (50 mm to 150 mm) shall have 1/16-inch (1.5 mm) diameter perforations.

3. Sizes 8-inch to 12-inch (200 mm to 300 mm) shall have 1/8-inch (3 mm) diameter perforations.

4. Sizes larger than 12-inch (300 mm) shall have 5/32-inch (4 mm) diameter perforations.

D. Design Pressure: Provide strainers designed for 125 pounds per square inch (860 kPa) working pressure on systems less than 125 pounds per square inch. Provide 250 pounds per square inch (860 kPa). Provide 1720 kPa design strainers for systems up to 250 pounds per square inch (1720 kPa) working pressure.

E. Strainer Free Area: The free area of each strainer screen shall be not less than three times the area of the strainer inlet pipe.

F. Drain Valves: Strainers shall have a blowdown connection with a gate or globe valve, bronze body, working pressure to match the strainer. Blowdown connections shall have a male threaded end for standard ¾ inch (20 mm) female hose connection. Provide threaded end cap.

2.14 BALANCING DEVICES

A. Types: Wherever "Balancing Valves", "Balancing Cocks", or similar words are used on the Contract Drawings, provide ball valves, resilient face eccentric plug valves, multi-purpose plug valves or butterfly valves for balancing purposes.

B. Butterfly Valves: Provide butterfly valves conforming to MSS SP 67 with single flange or lug type end connections which will anchor the valve body in place when either one or the adjacent flanged connection is unbolted.

C. Ball Valves: Provide ball valves conforming to MSS SP 72.

1. Provide one piece bodies on sizes 1-inch (25 mm) and smaller.

2. Provide top entry or split body type on sizes 1-1/2-inch (40 mm) and larger.

D. Locking Device: On each balancing valve size 1-1-2-inch (40 mm) and larger provide a locking device, with indicator, to secure the valve in the balanced position. If standard with the manufacturer, the locking device may be arranged so that the valve may be closed and then returned to its original balanced position.

E. Stems and Hand Operators: Design valves with stems and hand operators of sufficient length to project outside of 2-inch (50 mm) thick insulation. Indicators and locking devices shall be exposed.

F. Precision Plug Valve: In lieu of other balancing valves specified, at the Contractor's option precision all brass or bronze plug valves may be furnished.

1. Provide internal "O" ring or Teflon seals to prevent leakage.

2. Machined orifice or low loss Venturi shall be calibrated and provided with four laminated pressure-flow charts for any valve position between fully opened and fully closed.

3. Provide a calibrated plate and pointer mounted on the valve to indicate the degree of valve opening.

4. Provide a quick disconnect gauge connection of bronze or stainless steel.

G. Balancing Fittings: Where shown on drawings, on pipe sizes 3/4-inch (19 mm) diameter and smaller, provide balancing fittings on runouts to fan coil units, fin tube radiation, convectors and reheat coils as follows:

1. Fittings shall be of the combination balancing and shut-off type with the balancing device positioned by an Allen set screw or other approved method which permits closing of the valves without disturbing its balanced position.

2. Bodies may be of the globe or "Y" type with contour flow plug or approved equivalent.

3. Provide a graduated dial or other device to indicate the valve setting.

4. Gland shall permit packing under pressure.

5. Materials and construction shall be as specified for water valves sizes 1-1/2-inch (40 mm) and smaller.

6. On sizes 3/4-inch (19 mm) and smaller ends may be sweat or compression type.

H. Automatic Flow Control Valves -- Option: On constant volume systems containing no modulating or 3-way valves, automatic flow limiting and control valves may be provided in lieu of balancing valves and associated primary flow measuring elements shown on the drawings.

1. Increase system pump heads to compensate for minimum operating differential required for automatic control valves.

2. Adjust motor sizes, wiring, starters and circuit breakers to adjust for increased horsepower at no additional cost.

3. Factory select and calibrate valves for the flow quantity shown on the drawings.

4. Valves shall maintain constant flow rates and automatically compensate for changes in flow or head in other portions of the system.

5. Valves shall regulate flow within plus or minus 5 percent of their factory stamped flow quantity over differential range from 1/2 to 10 times the factory stamped differential pressure. Operating ranges shall be not less than 1 psi to 8-psi (7 kPa to 55 kPa) differential pressure.

6. Provide quick connect tappings to allow a factory furnished meter to be attached to measure flow quantities. Furnish a suitable meter and flow curves.

7. Provide valves of the self-cleaning, cartridge-piston type with stainless steel variable area orifices.

8. Construct valves for a working pressure of 125 pounds per square inch (860 kPa)or 150 percent system operating pressure, whichever is greater.

9. Provide valves with threaded or flanged connections to match adjacent pipe sizes.

10. Should field testing determine that branch flows are excessive, deficient and not in accordance with contract document requirements, automatic flow control valves shall be removed, replaced or recalibrate by the manufacturer and reinstalled at no additional cost.

I. Automatic Flow Control Valves -- Required: Automatic flow control valves shall be provided where shown on drawings.

1. Factory select and calibrate valves for the flow quantity shown on drawings.

2. Valves shall maintain constant flow rates and automatically compensate for changes in flow or head in other portions of the system.

3. Valves shall regulate flow within plus or minus 5 percent of their factory stamped flow quantity over differential range from 1/2 to 10 times the factory stamped differential pressure. Operating ranges shall be not less than 1 psi (7 kPa) differential pressure and not greater than 3 psi (21 kPa) at balanced flow. Pressure resistance potentially available to hold flow down to design flow shall be at least 40 psi (275 kPa).

4. Provide quick connect tappings for a factory furnished meter to be attached to measure flow quantities.

5. Provide valves of the self-cleaning type, cartridge-piston type with stainless steel variable area orifices.

6. Construct valves for a working pressure of 150% of the system operating pressure.

7. Valve end connections shall be threaded or flanged to match adjacent piping connections.

2.15 EXPANSION LOOPS

A. General: Provide expansion loops or offsets where required to relieve excessive stress in piping systems.

B. Construction: Construct loops and offsets with pipe and long turn factory-made welded fittings sized to limit the stress in any part of the loop or piping system to the values in ANSI B31.1. Use ASTM A 53 or A 106 pipe and fittings.

1. Size expansion loops without cold spring.

2. Provide two pipe guides, one on each side of each loop, and anchor to the building construction.

2.16 PIPE ANCHORS

A. General: Provide pipe anchors where required to restrain the movement of piping systems.

1. Anchors shall be suitable for the location of installation and shall be designed to withstand all forces and movements acting on the anchor.

2. Design anchors with a safety factor of four.

3. Anchor vertical piping with steel clamps welded to the piping and secured to the wall or floor construction.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Sizes: Provide piping systems of sizes indicated on the drawings. Systems shall be installed complete.

B. Codes: Install piping systems in conformance with ANSI B31.

C. Expansion: Install piping to allow for expansion and contraction of the piping systems. Provide offsets and swing joint connections at coils, pumps and other equipment to eliminate undue strain to the equipment connections.

1. Connect flanges and tack weld-piping systems in place before full circumferential welds are made.

2. Springing of piping at equipment connections will not be permitted.

3. The use of "cold-spring" is not permitted.

D. Branch Connections: Branch connections to up feed systems shall be made at the top or at a 45-degree angle above the centerline. Branch connections for down feed systems shall be made at the bottom or at a 45-degree angle below the centerline.

E. Pitch: Install water piping with a slope of not less than 1-inch in 40 feet (1:500).

1. Low points of hydronic systems shall be constructed to be in mechanical rooms as much as possible. Low points and bottoms of risers shall have ¾ inch (20 mm) diameter valve drains with male threaded ends for standard female hose connection for draining. Provide threaded end caps.

F. High Points: At each high point of the piping system provide a 3/8-inch (10 mm) diameter plugged globe valve.

1. Where high points are located in an inaccessible position, provide a 3/8-inch (10 mm) diameter bleed line from the high point of the piping system and extend to an approved

location, with access. Anchor bleed piping and provide 3/8-inch (10 mm) diameter globe valve.

G. Vibration and Flexibility: Support, anchor, and guide piping systems to preserve piping flexibility and the isolation effects of sound and vibration isolation hangers.

H. Flexible Connections: Flexible connectors shall be provided where indicated. Flexible connections shall be provided for connection points to air compressors, refrigeration equipment and all other vibrating equipment.

I. Welding: Conform to the welding and welder qualification requirements of "Quality Assurance" paragraph of this Section.

1. Perform welding in conformance with ANSI B31.1.

2. Perform welding in ambient temperatures above 0F (18C).

3. Ream and clean ends of piping.

4. Support piping, align and tack weld-making allowance for pipe pitch and insulation. Temporarily block piping at hangers.

5. Use welding pipe clamps on piping 4-inch (100 mm) diameter and larger, and verify alignment before welding.

J. Weld Testing: Provide testing on piping 12-inch (300 mm) diameter and larger and on piping systems operating in excess of 75 psig (520 kPa).

1. Test by means of radiograph, ultrasonic, sectioning or a combination of these methods at the option of the Contractor.

2. Test 6 welds where directed by the representative of the Contracting Officer.

3. Test shall be performed by a recognized independent testing agency. Submit test reports.

3.2 CLEANING

A. Pipe Exterior: Wash and wipe pipe exterior to remove construction dirt, loose scale and flux.

B. Pipe Interior: Flush pipe interior with clean water. Continue flushing until the piping system runs clean. After flushing inspect strainer screens, refrigeration machine water boxes, piping low points, and tank drains to determine the presence of construction debris. If debris is found, disassemble equipment and remove debris. Reflush the system and re-inspect.

1. Do not operate centrifugal pumps until system has been cleaned and flushed.

3.3 TESTING

A. 125-Pound (860 kPa) Systems: Test hydronic piping systems at not less than 150 pounds per square inch gauge (1030 kPa) or 1-1/2 times the maximum working pressure of devices connected to the piping system, whichever is greater, measured at the low point of the system.

B. 250-Pound Systems: Test at 300 pounds per square inch (2070 kPa) or 1-1/2 times the maximum working pressure of devices connected to the system, whichever is greater, measured at the low point of the system.

C. Test Procedures: Test system as follows:

1. Gag safety valves during testing.

2. Fill the system and remove all air.

3. Apply test pressure when water and ambient temperature are approximately equal and constant.

4. Maintain test pressure for one hour without adding any additional fluid to the system.

5. If the system shows loss in pressure, determine and repair leaks and retest the system. System shall show no loss in pressure for one hour.

6. Leaks in screw fittings shall be corrected by remaking the joints.

7. Leaks in welded joints shall be cut out and re-welded. Caulking will not be permitted.

END OF SECTION 15510

SECTION 15520 - STEAM AND STEAM CONDENSATE PIPING AND SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Extent of steam and condensate piping, fittings, valves, specialties and accessories is indicted on the drawings, in schedules and by the requirements of this Section, and Section 15010, "Mechanical Basic Requirements."

B. Types: Types of steam and condensate piping and specialties specified in this Section include:

1. Steam supply.
2. Condensate return.
3. Pumped condensate return.

C. Related Sections: Refer to other Division 15 sections for the following:

1. Hydronic Piping Systems.
2. Meters and Gauges.
4. Mechanical Identification.
5. Mechanical Insulation.
7. Heat Exchangers.
8. Automatic Control Systems.
9. Testing, Adjusting and Balancing.

D. Other Divisions: Refer to other divisions of the specification for the following:

1. Field Painting: Division 9.
2. Firestopping: Division 7.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Provide steam and steam condensate piping and specialties conforming to the following:

1. American National Standards Institute (ANSI):

a. B16.3 Malleable Iron Threaded Fittings

b. B16.5 Pipe Flanges and Flanged Fittings

c. B16.9 Factory-Made Wrought Steel Buttwelding Fittings

d. B16.11 Forged Steel Fittings, Socket-Welding and Threaded

e. B16.34 Valves - Flanged and Buttwelding

f. B16.39 Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300 1030, 1720, and 2070 kPa

g. B31 Code for Pressure Piping

h. B31.1 Power Piping

i. Z49.1 Safety in Welding and Cutting

2. American Society of Mechanical Engineers (ASME): Installation of piping shall conform to the requirements of ANSI B31.1 "Power Piping."

3. American Society for Testing and Materials (ASTM):

a. A 53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded Seamless

b. A 105/ A 105M Standard Specification for Forgings, Carbon Steel for Piping Components

c. A 106 Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service

d. A 193/ A 193M Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service

e. A 194/ A 194M Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service

f. A 216/ A 216M Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding for High-Temperature Service

g. A 234/ A 234M Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures

h. A 307 Standard Specification for Carbon Steel Bolts and Studs, 60 000 psi (413,700 kPa) Tensile Strength

i. B 61 Standard Specification for Steam or Valve Bronze Castings

j. B 62 Standard Specification for Composition Bronze or Ounce Metal Castings

4. American Welding Society, Inc. (AWS): Welding and safety procedure shall conform to the requirement of the AWS B2.1, "Welding Procedure and Performance Qualification," and ANSI Z49.1, "Safety in Welding and Cutting."

5. Fluid Controls Institute (FCI): Comply with the requirements of FCI 87.1, "Classifications and Operating Principals of Steam Traps."

6. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):

a. SP 45 By-Pass and Drain Connection Standard

b. SP 70 Cast Iron Gate Valves, Flanged and Threaded Ends

c. SP 71 Cast Iron Swing Check Valves, Flanged and Threaded Ends

d. SP 80 Bronze Gate, Globe, Angle and Check Valves

e. SP 85 Cast Iron Globe and Angle Valves Flanged and Threaded Ends

B. Qualification of Welders: Welders performing work under this Contract shall be certified and qualified in accordance with tests prescribed by the National Certified Welding Bureau (NCWB) or by other approved test procedures using methodology and procedures covered in the ASME Boiler and Pressure Vessel Code, Section IX, "Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators."

1. Submit for approval names, identification, and welder's assigned number, letter or symbol for each welder assigned to this project.

2. The assigned identification symbol shall be used to identify the work of each welder and shall be indelibly stamped immediately upon completion of each weld.

3. Welders shall be tested and certified for all positions.

4. Submit identifying stenciled test coupons made by each operator, if requested.

5. Welders will retake welding certifying tests, at no additional expense if requested.

6. When so requested, a welder shall not be permitted to work as a welder on this project until he has been recertified in accordance with NCWB.

7. Recertification of the welder shall be resubmitted after the welder has taken and passed the required tests.

8. Where piping 1½ inch (40 mm) and smaller is butt or socket welded, submit 3 samples of test welds for approval.

C. Qualifications of Radiographic Examiner: Personnel conducting radiographic examinations shall conform to the qualification requirements of the American Society for Nondestructive Testing, Inc. (ASNT) Publication SNT-TC-1A, "Recommended Practice for Personnel Qualifications and Certification."

1.3 SUBMITTALS

A. Division 1: Refer to Section 01003, "Submittals," for basic information relating to submittal requirements.

B. Product Data: Submit manufacturer's standard technical product data indicating conformance to the stipulated reference specifications, construction materials, construction details, and test and operating pressures. Submit manufacturer's product data on the following:

1. Pipe materials.
2. Unions and flanges.
3. Welding fittings.

4. Valves.
5. Strainers.
6. Supports.
7. Anchors.
8. Steam traps.
11. Steam vents.
12. Steam safety valves.

C. Shop Drawings: Provide piping layout drawings, drawn to a scale of not less than 1/4-inch to 1 foot (1:50) showing the proposed layout of piping systems including valves, fittings, equipment, supports, guides, hangers, grading, high points, low points, drain and drip points, anchors, and expansion devices. Provide shop drawings for the following locations:

1. Air handling equipment rooms.
2. Pipe shafts containing more than 1 pipe system.
3. Heating coils.

1.4 STORAGE AND PROTECTION

A. Storage: Store piping on the project site so as to preclude the entrance of construction dirt and debris into the open ends of piping. Do not install piping fouled with construction dirt.

B. Storage of Fittings: Store fittings under cover, protected from construction dirt and rain.

C. Storage of Valves and Specialties: Store valves and specialties under cover with blind or protective wood flanges secured to valve and specialty openings. Valves and specialties fouled with construction dirt shall be removed from the project site and replaced with new.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (Not Used)

2.2 PIPING MATERIALS

A. Steam Piping: Provide black steel, Schedule 40 steam piping conforming to ASTM A 53, Grade B, Seamless or ASTM A 106, Grade B, Seamless.

B. Condensate Piping: Provide black Steel, Schedule 80 condensate piping conforming to ASTM A 53, Grade B, Seamless or ASTM A 106, Grade B, Seamless.

C. Steam Trap Station Piping: Provide steam trap station piping as follows:

1. Maximum 125 psig (860 kPa) working pressure, black steel, Schedule 80, conforming to ASTM A 53, Grade B, Seamless or ASTM A 106, Grade B, Seamless.

2. Maximum 250 psig (1720 kPa) working pressure, black steel, Schedule 160, conforming to ASTM A 53, Grade B, Seamless or ASTM A 106, Grade B, Seamless.

2.3 PIPE FITTINGS: 125 psig (860 kPa) MAXIMUM WORKING PRESSURE

A. Fittings 50 mm and Smaller: Pipe fittings for piping 50 mm and smaller shall be tested and permanently stamped for 125 psig (860 kPa) working pressure and conform to the following:

1. Threaded malleable iron elbows, tees, plugs and caps conforming to ANSI B16.3, Class 1030 kPa.

2. Provide ASTM A 105/A 105M carbon steel flanges conforming to ANSI B16.5, Class 1030 kPa.

3. Provide malleable iron unions, with bronze facings conforming to ANSI B16.39.

4. Provide bolts and nuts conforming to ASTM A 307, Grade B up to 860-kPa working pressure.

B. Fittings 2½ (65 mm) Diameter and Larger: For working pressures not exceeding 860-kPa pressure provide fittings as follows:

1. Provide ASTM A 234/A 234M carbon steel butt welding tees long radius pattern, long radius elbows, reducers, and caps conforming to ANSI B16.9, Schedule 40, each stamped by the manufacturer for conformance and working pressure.

2. Provide ASTM A 105/A 105M carbon steel flanges conforming to ANSI B16.5, socket weld or welding neck pattern.

3. Provide bolts and nuts conforming to ASTM A 307, Grade B up to 860-kPa working pressure.

2.5 STEAM VALVES: MAXIMUM 100 kPa STEAM WORKING PRESSURE

A. General: Conform to the requirements of condensate valves, maximum 860-kPa system working pressure.

2.6 STEAM VALVES; MAXIMUM 860 kPa STEAM WORKING PRESSURE

A. Valves 40 mm and Smaller: On systems not exceeding 860-kPa working pressure, provide valves conforming to the following:

1. Construct valves of ASTM B 62 bronze in conformance with MSS SP 80, Class 1030 kPa.

2. Ends shall be threaded, union bonnet with rising stem.

3. Valves shall be gate or globe valves as indicated on the drawings.

B. Gate and Globe Valves 2 and 3 inches (50 mm and 75 mm) Diameter: Provide gate and globe valves conforming to the following:

1. Provide valves of bronze or cast steel bodies.

2. Bronze body shall conform to the requirements of valves 1½ inch (40 mm) and smaller.

3. Cast steel body shall conform to the requirements of valves 4 inch (100 mm) and larger.

C. Gate and Globe Valve 100 mm and Larger: Provide gate and globe valves conforming to the following:

1. Cast valves of ASTM A 216/A 216M, Grade WCB carbon steel.

2. Gate valves shall conform to ANSI B16.34, Class 1030 kPa, OS&Y rising stem pattern with chromium or hard faced steel seat rings, solid wedge disc, and flanged end connections.

3. Globe valves shall conform to ANSI B16.34, Class 1030 kPa, OS&Y rising stem pattern with conical tapered chromium plug and seat, and flanged end connections.

D. Handwheels: Provide handwheels of ductile iron, malleable iron or steel.

2.8 CONDENSATE VALVES: MAXIMUM 860 kPa SYSTEM WORKING PRESSURE

A. Valves 40 mm and Smaller: On systems not exceeding 860 kPa working pressure provide valves conforming to the following:

1. Construct valves of ASTM B 62 bronze in conformance with MSS SP 80, Class 860 kPa.

2. Ends may be threaded or solder connection type.

3. Valves shall be gate, globe, or check valves as indicated on the drawings.

B. Gate, Globe and Check Valves 50 mm and 75 mm Diameter: Provide gate, globe and check valves conforming to the following:

1. Provide valves with bronze or cast iron bodies,

2. Bronze body shall conform to the requirements of valves 40 mm and smaller.

3. Cast iron body shall conform to the requirements of valves 100 mm and larger.

C. Gate, Globe, Check Valve 4 inch (100 mm) and Larger: Provide gate, globe and check valves rated for 860-kPa water working pressure. Conform to the following:

1. Construct valves of ASTM A 126, Class B cast iron or ASTM A 216/A 216M, Grade WCB cast steel.

2. Gate valves shall conform to MSS SP 70, Class 860 kPa, OS&Y rising stem pattern, with bronze seats, solid wedge disc, bronze stem and flanged end connections.

3. Globe valve shall conform to MSS SP 85, Class 860 kPa, rising stem pattern with bronze seats replaceable Teflon plug facing, bronze stem, and flanged end connections.

D. Handwheels: Provide handwheels of ductile iron, malleable iron or steel.

E. Check Valves, Swing Pattern: Provide swing pattern type check valves conforming to the requirements of MSS SP 71 and as follows:

1. Body shall be cast iron with flanged end connections, bronze disc holder, resilient disc, bronze seats, cast iron flanged cap and resilient gasket.

2.10 TRAP AND DRIP STATION VALVES

A. General: Conform to the requirements of steam valves for the working pressure of the associated steam piping system.

2.11 VALVE BYPASSES

A. Valves 12-inch (300 mm) Diameter and Larger: Provide bypasses in all valves 12-inch (300 mm) diameter and larger. Valves shall be sized by the manufacturer, not less than 1-inch (25-mm) diameter, 250 pounds (1720 kPa) working pressure. Bypass shall conform to MSS SP 45, Series A.

   1. On systems with an operating pressure greater than 30 pounds per square inch, (210 kPa), bypasses shall be of the 3-valve type, with two plugged blow-off valves and a shut-off valve.

B. Valves 6-inch (150 mm) Diameter and Larger: On systems with an operating pressure in excess of 125 pounds per square inch, (860 kPa), provide 3-valve bypasses for valves 6-inch (150 mm) diameter and larger.

   1. 3-valve bypasses shall consist of two threaded and plugged blow-off valves and a shut-off valve.

   2. Select valves for 250 pounds (1720 kPa) working pressure.

2.12 CHECK VALVES

A. Types: Provide valves of the swing or lift types, designed 860 kPa steam working pressure.

B. Bodies: Provide threaded or flanged type bodies constructed of bronze ASTM B 61, cast steel ASTM A 216/A 216M Grade WCB, Class 150 (1030 kPa) construction for working pressures 125 psig (860 kPa) and below and Class 300 (2070 kPa) for working pressure of 250 psig (1720 kPa) and below.

C. Trim: Seats and discs shall be constructed of 18-8 stainless steel or bronze complying with ASTM B 62. Seats may be of elastomers suitable for 250F (120 degrees C) minimum continuous working temperature or not less than 50F (10 degrees C) above the operating temperature of the system, whichever is higher.

D. Mating Surfaces: Mating surfaces of closure faces shall be bronze or Type 316 or 17-4PH stainless steel or elastomer approved for the particular service and materials must be compatible to prevent electrolytic action.

E. Pressure Loss: Pressure loss through the valves, measured in feet of water,kPa, shall not exceed 6/10 of the water velocity in feet per second (metre/second).

F. Bubble-Tight: Check valves shall provide bubbletight shut-off when handling water up to 250 degrees F. and 125 pounds per square inch (120 degrees C and 860 kPa) differential pressure. Design shall prevent rubbing of seat materials when opening and closing.

2.13 STRAINERS

A. Types: Provide strainers of the "Y" or basket types as indicated on the drawings or required to suit the field conditions.

B. Strainers 40 mm Diameter and Smaller: Provide strainers with bronze bodies conforming to ASTM B 62, Grade C or cast steel conforming to ASTM A 216/A 216M, Grade WCB.

1. End connections shall be threaded.

2. Screens shall be bronze on brass body strainers and 18-8 stainless steel on cast steel body strainers with 0.8-mm diameter perforations.

C. Strainers Size 2 inch (50 mm) and Larger: Provide strainers with cast steel bodies conforming ASTM A 216/A 216M, Grade WCB with flanged end connections.

1. Screens shall be monel metal or 18-8 stainless steel.
2. Sizes 50 mm to 150 mm shall have 1.5-mm diameter perforations.
3. Sizes 200 mm to 300 mm shall have 3-mm diameter perforations.
4. Sizes larger than 300 mm shall have 4-mm diameter perforations.

D. Design Pressure: Provide strainers designed for 2070 kPa working pressure on systems less than 860 kPa

E. Strainer Free Area: The free area of each strainer screen shall be not less than three times the area of the strainer inlet pipe.

F. Drain Valves: For each strainer 1½ inch (40 mm) diameter and larger, provide a plugged ½ inch (13 mm) diameter gate valve, bronze body, working pressure to match the strainer, threaded with a plugged outlet.

2.14 VACUUM BREAKERS

A. General: Provide swing check valves conforming to requirements for cheek valves with elastomer disc seating and machined metal seat.

2.16 EXPANSION LOOPS

A. General: Provide expansion loops or offsets where required to relieve excessive stress in piping systems.

B. Construction: Construct loops and offsets with long radius factory-made weld fittings and sized to limit the stress in any part of the loop or piping system to the values in ANSI B31.1.

1. Size expansion loops without cold spring.

2. Provide two pipe guides, one on each side of each loop, and anchor to the building construction.

2.17 PIPE ANCHORS

A. General: Provide pipe anchors where required to restrain the movement of piping systems.

1. Anchors shall be suitable for the location of installation and shall be designed to withstand all forces and movements acting in the anchor.

2. Design anchors with a safety factor of four.

3. Anchor vertical piping with steel clamps welded to the piping and secured to the wall or floor construction.

2.18 STEAM TRAPS

A. General: Provide steam traps where and of the types indicated on the drawings or where required to properly drain condensate, air, and non-condensable gases from the steam piping system and connected coils, heat exchangers, and equipment.

B. Types: Steam traps shall be of the following types:

1. Thermostatic
2. Float and thermostatic

C. Finish: Traps adjacent to equipment requiring special finishes such as aluminum, brass, chromium, copper, nickel-alloy, or stainless steel, shall have brass bodies chromium plated.

D. Ratings: Trap capacity ratings shall conform to the standards of the Steam Heating Equipment Manufacturers Association (SHEMA) for continuous elimination of air when trap is operating at its maximum rating.

E. Certified Test Data and Guarantee: Submit certified test data noting compliance with cycling requirements along with manufacturers guarantee and catalog data.

1. Failure of any solder or welded joint, or of element metal, due to element fatigue after installation in the field during the one-year guarantee period, shall require review of the total number of element failures.

2. Provide traps of another design when in excess of 3 percent of trap elements fail.

F. Capacities: Provide traps of capacities indicated on drawings. If not indicated, size traps at five times equipment hourly condensate rate except steam line drip traps and traps used in conjunction with air heating units. Size traps at three times hourly condensate rate for equipment without modulating type control. Comply with trap manufacturers recommendations.

H. Float and Thermostatic Traps:

1. Provide trap of the closed float type.

2. Construct thermostatic elements of phosphor bronze, balanced pressure design with minimum 6 corrugations.

3. Construct body of cast iron for system pressures 125 psig (860 kPa) and below and of ASTM A 216/A 216M, Class WCB cast steel for pressures above 125 psig (860 kPa).

4. Construct floats of brass, copper, heavy copperclad steel or stainless steel.

5. Construct seats for operating pressures 15 psig (100 kPa) and below of hard bronze, monel on stainless steel. For pressures above 15 psig, (100 kPa), seats shall be hardened monel or stainless steel.

6. Seats and mechanical elements shall be replaceable.

7. Size trap capacity with 2-psi (14-kPa) differential across trap in accordance with FCI 87.1.

I. Thermodynamic Traps:

1. Provide trap of the thermodynamic disk type consisting of body, cap and disk.

2. Construct of stainless steel bar stock, with hardened seat and disk. Design for 860 kPa working pressure.

3. Passages shall be large and unobstructed to pass air and condensate.

4. Install trap with minimum 10-psig (70-kPa) steam operating pressure and back pressure of 50 percent of the initial steam pressure.

5. Trap shall not be used with air heating coils.

6. Size trap based on inlet pressure in accordance with FCI 87.1.

2.19 STEAM VENTS

A. General: Provide steam vents where indicated on drawings and required to vent air and non-condensable gases from steam piping system.

B. Quick Vents: Construct quick vents with ASTM B 62 cast bronze body, beryllium copper bellows with minimum 6 corrugations, and stainless steel seat and valve.

C. Float Vents: Construct float vents with ASTM A 216/A 216M, Grade WCB cast steel, semi-steel or ASTM A 105/A 105M forged steel body, seamless brass or 316 stainless steel float, and removable stainless steel seat and valve.

D. Ratings: Rate vent bodies 250 psig (1720 kPa) for steam operation pressures 125 psig860 kPa and below, and 400 psig for 250 psig (2760 kPa for 1720 kPa) and below.

2.20 PRESSURE REDUCING VALVES

A. General: Provide external pilot operated pressure-reducing valve with remote pressure sensing tube connected to the down stream of the valve. Valves shall be single seated, dead-end service types.

B. Types: The following are acceptable designs:

1. Pilot operated main diaphragm, steam pressure operated.
2. Air loaded pilot, steam pressure operated.
3. Air regulating pilot, air pressure operated.

4. Sliding disc and fixed plate in lieu of plug and disc.

C. Delivery Pressure: Maintain constant delivery pressure within plus or minus 1/4 pound over full range with input pressure variations of plus or minus 20 percent.

D. Construction: Construct valve bodies of cast bronze or cast steel.

E. For 125 psig (860 kPa) operating pressure and below, provide bodies rated at 250 psig at 400 degrees F., (1720 kPa @ 205 degrees C).

F. Connections: Valve bodies 2-inch (50 mm) and smaller shall be threaded, 2-1/2-inch (65 mm) and larger shall be flanged.

G. Seats: Provide removable seats and plugs constructed of heat-treated stainless steel, high chromium steel or stellite faced.

H. Diaphragms: Construct metal diaphragms of phosphor bronze, monel or stainless steel. Composition diaphragms on air operated valves shall be suitable for the temperature.

I. Air Regulator/Filter Assembly: Provide combination air regulator and filter assembly with each air loaded pilot used to control a steam or air operated valve.

J. Pressure Gauges: Provide pressure gauges on inlet and control air lines.

K. Pressure regulator capacity shall not be greater than 120% of specified system maximum capacity. Regulator sound pressure level while operating at specified maximum capacity shall not exceed the dbA limits indicated in the schedule as measured at a point 0.91 meter downstream and 0.91 meter from uninsulated pipe. Unions shall be used on either side of screwed end by-pass valve and pressure reducing regulator to facilitate removal.

L. Sizes: Size parallel valves on a 1/3, 2/3 basis. Maximum valve size, 100 mm unless this limitation would require more than 3 valves per stage.

M. Gate Valves: Provide line size gate valves and unions each side of reducing valve.

N. Globe Valves: Provide a maximum 2½ inch (65 mm) globe valve bypass on each stage of a reducing station.

2.21 SAFETY OR RELIEF VALVES

A. General: Provide safety or relief valves complying with ASME Code for Power Boilers or the ASME Code for Unfired Pressure Vessels, where indicated on drawings or required for a proper installation.

B. Type: Design to permit seat and disc maintenance without disassembly of piping.

C. Safety Valve: Provide 25 mm size brass body ASME approved warning safety valve on steam pressure reducing stations with inlet pressure of 275 kPa or less.

D. Setting: Set valves per ASME recommendations.

F. Drains: Provide drains at low points in safety valve discharge piping.

G. Drip Pan: Provide cast iron drip pan elbow sized for safety valve outlet connection.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Sizes: Provide piping systems of sizes indicated on the drawings. Systems shall be installed complete.

B. Codes: Install piping systems in conformance with ANSI B31.

C. Expansion: Install piping to allow for expansion and contracting of the piping systems. Provide offsets and swing joint connections at tanks, coils, and other equipment to eliminate undue strain to the equipment connections.

1. Connect flanges and tack weld-piping systems in place before full circumferential welds are made.

2. Springing of piping at equipment or expansion loop connections will not be permitted.

D. Drip Connection: Provide dirt pocket and trap station at the end of each main, all low points in system and at the base of each riser.

E. Pitch: Install condensate piping with a pitch or slope of not less than 1-inch in 40 feet,1:500, down in the direction of flow.

1. Provide 3/4-inch (19 mm) diameter plugged drain valves at each low point in mechanical rooms.

F. High Points: At each high point of the piping system provide a 3/8-inch (10 mm) diameter plugged globe valve.

1. Where high points are located in an inaccessible position, provide a 3/8-inch (10 mm) diameter bleed line from the high point of the piping system and extend to an approved location, with access. Anchor bleed piping and provide 3/8-inch (10 mm) diameter globe valve.

G. Vibration and Flexibility: Support, anchor, and guide piping systems to preserve piping flexibility and the isolation effects of sound and vibration isolation hangers.

H. Welding: Conform to the welding and welder qualification requirements of the "Quality Assurance" article of this Section.

1. Perform welding in conformance with ANSI B31.1.

2. Perform welding in ambient temperatures above 0 degrees F. (-18 degrees C).

3. Ream and clean ends of piping.

4. Support piping, align and tack weld-making allowance for pipe pitch and insulation. Temporarily block piping at hangers.

5. Use welding pipe clamps on piping 4-inch (100 mm) diameter and larger, and verify alignment before welding.

I. Weld Testing: Provide testing on piping 12-inch (300 mm) diameter and larger and on piping systems operating in exceed of 75 psig. (520 kPa).

1. Test by means of radiograph, ultrasonic, sectioning or a combination of these methods at the option of the Contractor.
2. Test 6 welds where directed.

3. Test shall be performed by a recognized independent testing agency. Submit test reports.

3.2 CLEANING

A. Pipe Exterior: Wash and wipe pipe exterior to remove construction dirt, loose scale and flux.

B. Pipe Interior: Flush pipe interior with clean water. Continue flushing until the piping system runs clean. After flushing, inspect strainer screens, piping low points, and tank drains to determine the presence of construction debris. If debris is found, disassemble equipment and remove debris. Reflush the system and re-inspect.

3.3 TESTING

A. Test steam and steam condensate piping systems at not less than 100 pounds per square inch gauge (690 kPa) or 1-1/2 times the maximum working pressure of devices connected to the piping system.

1. Cage safety valves during testing.

2. Fill the system with water and remove all air.

3. Apply test pressure when water and ambient temperature are approximately equal and constant.

4. Maintain test pressure for 1 hour without adding any additional fluid to the system.

5. If the system shows loss in pressure, determine and repair leaks and retest the system. System shall show no loss in pressure for 1 hour.

6. Leaks in screw fittings shall be corrected by remaking the joints.

7. Leaks in welded joints shall be cut out and re-welded. Caulking will not be permitted.

END OF SECTION 15520

SECTION 15830 - HEATING AND COOLING TERMINAL UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Extent of terminal unit work required by this Section is indicated on drawings and schedules, by the requirements of this Section, and Section 15010, "Mechanical Basic Requirements."

B. Types: Types of terminal units specified in this Section include the following:

1. Fan coil units.
2. Baseboard radiation.

C. Related Sections: Refer to other sections of Division 15 for the following:

1. Mechanical Insulation.
2. Hydronic Piping Systems and Hydronic Specialties.
3. Steam and Condensate Piping and Specialties.
4. Air Terminal Units.
5. Ductwork.
6. Automatic Control Systems.
7. Testing, Adjusting, and Balancing.

D. Division 16: Refer to Division 16 Section for the following:

1. Power Wiring.
2. Starters and Disconnects.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Provide terminal units conforming to the following:

1. Air-Conditioning and Refrigeration Institution (ARI): Comply with applicable ARI standards including the following:

   a. 350 Sound Rating of Non-Ducted Indoor Air-Conditioning Equipment.

   b. 410 Forced-Circulation Air-Cooling and Air-Heating Coils.

   c. 440 Standard for Room Fan-Coil Air-Conditioners.

2. Air Movement and Control Association, Inc. (AMCA): Comply with applicable AMCA standards including AMCA 210, "Laboratory Methods of Testing Fans for Rating Purposes."

3. American National Standards Institute (ANSI): Comply with applicable ANSI standards including S1.23, "Method for Designation of Sound Power Emitted by Machinery and Equipment."

4. Institute of Boiler and Radiator Manufacturers (IBR): Test and rate baseboard and finned tube radiation in accordance with IBR. Provide published ratings bearing emblem of IBR.

5. National Electrical Manufacturers Association (NEMA): Comply with applicable NEMA standards including MG 1, "Motors and Generators."

6. National Fire Protection Association (NFPA): Construct terminals using acoustical and thermal insulations complying with NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

B. Certification: Submit certification of terminal unit's compliance with performance shown on the drawings.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's catalog cuts for terminal units showing dimensions, capacities, ratings, performance characteristics, gauges and finishes of materials, and installation instructions.

B. Shop Drawings: Submit shop drawings showing unit dimensions, construction details, and field connection details.

C. Samples: Submit 3 samples of each type of cabinet finish.

D. Maintenance Data: Submit maintenance instructions, including lubrication instructions, filter replacement, motor and drive replacement, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 1.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Handling: Handle terminal units and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged air terminal units or components; replace with new.

B. Storage: Store terminal units and components in clean dry place. Protect from weather, dirt, water, construction debris, and physical damage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (Not Used)

2.2 FAN COIL UNITS

A. General: Provide fan coil units with capacities as indicated in the schedule on the drawings. Provide fan coil units factory assembled and consisting of multi-speed motor-driven fans, supply grilles, and cooling coils, piping hookups, drip pans, air filters, fan speed switch, acoustical and thermal insulation treatment, and enclosures.

B. Sound Levels: Provide fan coil units with sound power levels at specified operating capacity in accordance with ARI 350.

C. Enclosure: Provide each unit with a rigid enclosure of steel not lighter than 0.06 inch (1.5 mm).

1. The enclosure shall be provided with a stamped adjustable double deflection supply grille and inlet grille or slot at the floor line.

2. Flush door or doors shall be provided in the top panel for access to all adjustments and controls.

3. The enclosure shall be either removable as a whole or the front shall be removable to provide easy access to all internal parts.

4. Positive means shall be provided for leveling enclosures and internal parts.

D. Coils: Provide coils constructed of not less than 1/2 inch (13 mm) copper tubing and aluminum fins mechanically bonded to the tubes.

1. Provide manual air vent at high point of each coil.

2. Provide a drip pan beneath each coil, an extension or secondary drip pan beneath the control valve and piping hookups of each coil circuit. Drip pans shall be watertight, coated to prevent corrosion, insulated, and have a smooth internal surface to permit free drainage. Provide minimum ¾ inch (19-mm) diameter drain.

E. Filters: Provide filters of the viscous impingement throwaway type.

1. Provide tight fitting filters to prevent air bypass.

2. Provide filters with slide-out frames which are easily replaced without removing enclosure or any part thereof.

F. Fans: Provide fans of the centrifugal type, especially designed for quiet operation as installed. Wheels shall be statically balanced.

G. Electrical: Provide factory wiring in accordance with the requirements of Underwriters Laboratories. Provide a fan switch with an "OFF" and three fan speed positions.

H. Motors: Provide motors of the permanent split capacitor type with permanently oil lubricated bearings in accordance with NEMA MG 1.

2.3 BASEBOARD RADIATION

A. General: Provide baseboard radiation of lengths and in locations as indicated, and of capacities, style, and having accessories as scheduled.

B. Enclosures: Provide minimum 1 mm cold-rolled steel, one-piece back and top panel, front panel with integral damper. Provide steel brackets, inserted in back/top panel, to support element and front panel. Provide baked enamel finish.

C. Elements: Provide copper tube and aluminum fins, with slide mechanism between element and support brackets to eliminate expansion and contraction noises.

D. Accessories: Provide the following accessories:

1. Blank end caps.
2. End caps with hinged access panel.
3. Trim strips.

PART 3 - EXECUTION

3.1 INSTALLATION OF FAN COIL UNIT

A. General: Install fan coil units as indicated on drawings and in accordance with manufacturer's installation instructions.

B. Piping: Provide hookups for individual fan coil units of a standardized design, to provide a uniform arrangement with access for servicing and adjustment.

1. Piping shall be as shown on the drawings.

2. Hookup may be factory fabricated and furnished by unit manufacturer.

3. Hookups shall include shut off valve in each coil connection (supply and return), provision for controls, balancing cock, and all interconnecting piping.

3.2 ELECTRICAL WIRING

A. General: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to the electrical subcontractor.

1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 16 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment subcontractor.

3.3 INSTALLATION OF BASEBOARD RADIATION

A. General: Install baseboard radiation as indicated, and in accordance with manufacturer's installation instructions.

B. Locate baseboard radiation on outside walls as indicated, run cover continuous wall-to-wall unless otherwise indicated.

C. Center elements under windows. Where multiple windows occur over units, divide element into equal segments centered under each window.

D. Install end caps where units butt against walls. Install access panels centered in front of each shutoff valve, balancing cock, or temperature control valve.

3.4 ADJUSTING AND CLEANING

A. General: After construction is completed, including painting, clean unit exposed surfaces, vacuum

terminal coils and inside of cabinets.

B. Finish: Retouch any marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

C. Filters: Install new filter units for terminals prior to final acceptance.

END OF SECTION 15830

SECTION 15855 - AIR HANDLING UNITS FACTORY FABRICATED

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Extent of air handling unit work required by this Section is indicated on the drawings, by requirements of this Section, and Section 15010, "Mechanical Basic Requirements."

B. Related Sections: Refer to other sections of Division 15 for the following:

1. Supports and Anchors
2. Meters and Gauges
3. Mechanical Insulation
4. Hydronic Piping Systems
5. Sheet Metal Ductwork
6. Fibrous Glass Ductwork
7. Air Terminal Units
8. Automatic Control Systems
9. Testing, Adjusting, and Balancing

C. Division 16: Refer to Division 16 sections for the following:

1. Power Wiring.
2. Starters and Disconnects.

D. Other Divisions: Refer to other Divisions of the specification for the following work:

1. Field Painting: Division 9.
2. Structural Support: Division 5.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Provide air handling units that are the standard product of an equipment manufacturer regularly engaged in the production of such units who issues complete catalog information on such products. The Contractor shall not fabricate units.

B. Certifications: Provide certified ratings of units based on tests performed in accordance with ARI 430, "Central-Station Air Handling Units."

C. Codes and Standards: Provide air-handling units conforming to the following:

1. Air Movement and Control Association, Inc. (AMCA): Comply with applicable AMCA including:

   a. 210 Laboratory Methods of Testing Fans for Rating Purposes.

   b. 500 Test Method for Louvers, Dampers, and Shutters.

2. Air-Conditioning and Refrigeration Institute (ARI): Comply with applicable ARI including

the following:

a. 410 Forced-Circulation Air-Cooling and Air-Heating Coils.

b. 430 Central-Station Air-Handling Units.

3. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE): Construct and install refrigerant coils in accordance with ASHRAE 15, "Safety Code for Mechanical Refrigeration."

4. National Electrical Manufacturers Association (NEMA): Except for motors, provide electrical components required as part of air handling units, which comply with NEMA Standards.

5. National Fire Protection Association (NFPA): Provide air handling unit internal insulation having flame spread rating not over 25 and smoke developed rating no higher than 50; and complying with NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

   Comply with NFPA 70, "National Electrical Code," as applicable for installation and electrical connections of ancillary electrical components of air handling units.

6. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA): Comply with applicable SMACNA standards including "HVAC Duct Construction Standards - Metal and Flexible."

7. Underwriter's Laboratories, Inc. (UL): Except for motors, provide electrical components required as part of air handling units, which have been listed and labeled by UL.

1.3 SUBMITTALS

A. Division 1: Conform to the requirements of Division 1, Section 01003, "Submittals."

B. Product Data: Submit manufacturer's technical product data for air handling units showing dimensions, weights, capacities, ratings, fan performance with operating point clearly indicated, motor electrical characteristics, and finishes of materials, and installation instructions.

C. Shop Drawings: Submit shop drawings showing unit dimensions, weight loadings, required clearances, field connection details and methods of support. Draw to a scale of 1:20, using same sheet size as Contract Drawings. Include field fabricated mixing boxes, dampers and duct connections.

D. Maintenance Data: Submit maintenance instructions, including instructions for lubrication, filter replacement, motor and drive replacement, and spare parts lists. Include this data, product data, shop drawings, and wiring diagrams in operating and maintenance manuals; in accordance with requirements of Division 1.

1.4 DELIVERY, STORAGE AND HANDLING

A. Delivery: Deliver air handling units with factory-installed shipping skids and lifting lugs; pack small components in factory-fabricated protective containers.

B. Handling: Handle air-handling units carefully to avoid damage to components, enclosures, and finish. Do not install damaged components; replace and return damaged components to air handling unit manufacturer.

C. Storage: Store air handling units in clean dry place and protect from weather and construction traffic.

D. Unloading: Comply with manufacturer's rigging and installation instructions for unloading air handling units, and moving them to final locations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (Not Used)

2.2 AIR HANDLING UNITS

A. General: Provide units consisting of component sections, fan, filter, dampers, heating coils, cooling coils, and humidifiers in combinations required by the project drawings and schedules.

1. Single-zone unit fan-sections shall draw air through the filter and coil section.

2. Design unit fans and casings for and suitable for the maximum total static pressure of the fan or fans under all conditions.

B. Fans: Provide fans conforming to ARI 430 or AMCA 210 and of the backward-inclined airfoil type specifically designed and suitable for the operating pressure.

1. Provide fans with adjustable motor base designed to hold belts in positive alignment and proper tension.

2. Design fan shafts so that maximum operating speed does not exceed 75 percent maximum of the critical speed for the shaft.

3. Statically and dynamically balance fans.

4. Grease lubricate, ball bearing type bearings and size for an average bearing life not less than 200,000 hours.

5. Extend lubrication facilities so as to be readily accessible for maintenance while air-handling unit is in operation.

C. Motors and Drives: Provide fan motors with a nameplate rating of not less than 10 percent above the fan brake horsepower and drive loss at maximum capacities any point on the characteristic curve for forward curved fans and 5 percent for backward curved fans.

1. Each motor provided with automatic control shall be capable of making as frequent starts as the control device may demand. Motors not provided with automatic control shall be capable of making not less than 4 starts per hour.

2. Provide belt drives with a service factor not less than 1.4. Arrange belt drives to permit use of speed counters with the guards in place. Require belt guards on units having externally

mounted motors. Belt guards shall conform to OSHA requirements. Construct belt guards of mill galvanized or phosphate treated and prime finish coated steel with solid sides and face, bolted to fan housing and motor rails. Belt guards are not required on units having internally mounted motors.

3. Provide polyphase motors of the drip-proof, squirrel cage, induction type in accordance with NEMA MG 1. Polyphone motors shall be single-voltage type or increment starting types

4. Provide two motor sheaves, one of the adjustable pitch type to be used for air balance, and one of the fixed pitch type to be used for final rpm.

D. CASING

1. Unit shall be constructed of a complete structural frame with removable panels. Removal of side panels shall not affect the structural integrity of the unit. Contractor shall be responsible to provide connection flanges and all other framework that is needed on unit to ensure that removal of unit's panels shall not affect structural integrity. On units larger than 12 tons, manufacturer shall be able to ship each segment (filter, coil, fan) separate so that unit can be broken down for ease of installation in tight spaces

2. Panels shall be fully removable to allow for a proper way to thoroughly clean panels of microbial growth and to access internal parts. If panels are not removable, then manufacturer shall provide access sections with doors between all internal components to ensure access and cleanability of the air handler.

3. Construct casing sections located upstream of supply fan for operation at 4 inches water gage negative static pressure and casing sections located downstream of supply fan for operation at 6 inches water gage positive static pressure.

4. All exterior panels and structural frames shall be constructed of G90-U galvanized steel. Casings not constructed of G90-U galvanized steel, casings with welds on exterior surfaces, or casings with welds on interior surfaces that have burned through to exterior surfaces shall be chemically cleaned, coated with rust inhibiting primer, and finished with rust inhibiting enamel in order to prevent premature corrosion and microbial growth.

5. Seal and gasket all joints between exterior panels and structural frames with closed-cell foam gasketing for air seal and acoustical break.

6. Provide lighting inside the coil, humidifier and fan sections and case mounted switch outside the unit by the access door. All power wiring and installation shall be done by the unit manufacturer at the factory.

E. DRAIN PAN CONSTRUCTION

Drip-Pans: Provide each cooling coil section casing and all other sections indicated on the drawings with a 304 stainless steel-drip pan, not less than 1.3 mm thick, with drain connections.

1. Provide drip pans to collect, confine, and dispose of all condensate from cooling coils and attachments, including headers, return bends, distributors, and uninsulated pipe and fittings.
2. Allocate space in the coil bank to install a biocide drip bottle. Pipe all condensate into the sanitary system.

3. Drain pan shall be self draining

F. FANS

1. Provide supply fan section(s) with FC double width, double inlet centrifugal fan designed and suitable for class of service indicated in the unit schedule. Fan shaft to be properly sized and protectively coated with lubricating oil. Fan shafts shall be solid and properly designed so that fan shaft does not pass through first critical speed as unit comes up to rated RPM. Fans shall be statically and dynamically tested as an assembly at the required RPM to meet design specifications. Key fan wheels to fan shaft to prevent slipping.

2. Fan sections shall have full height, double wall, hinged, removable access doors on drive side for inspection and maintenance of internal components. Construct doors in accordance with Article 2.03 Paragraph E.

G. COILS

1. The same company as the supplier of the air-handling unit shall manufacture coils. Install coils such that unit casings enclose headers and return bends.

2. Construct coils of configuration plate fins and seamless tubes. Fins shall have collars drawn, belled and firmly bonded to tubes by means of mechanical expansion of tubes. Do not use soldering or tinning in bonding process.

3. Construct coil casings of galvanized steel with formed end supports and top and bottom channels. If two or more coils are stacked in unit, install intermediate drain channels between coils to drain condensate to main drain pans without flooding lower coils or passing condensate through airstream.

4. Provide coils with tubes and headers with non-trapping circuiting and correctly circuited for proper water velocity without exceeding specified maximum water pressure drop.

5. Provide coils with certified ratings based on ARI 410.

6. Steam Coils: Provide steam coils of the double-tube steam distributing type, constructed of cast semi-steel, welded-steel, or copper headers, copper headers, copper tubes, and copper or aluminum fins mechanically bonded or soldered or helically wound to tubes. Fins spacing shall not exceed be closer than 3mm.

- Tubes: Rolled and bushed, or brazed, to headers.
- Outer Tubes: Not less than 16mm outside diameter.
- Distributing Tubes: Not less 10mm outside diameter, with orifices to discharge steam to outer tubes.
- Distributing Tubes: Installed concentric inside of condenser tubes and shall be held securely in position.
- Limit the maximum length of a single coil to 150 times the diameter of the outside tube.
- Coil Casings and Tube Support Sheets: Not lighter than 1.6 mm nominal thickness galvanized steel, formed to provide structural strength.
- Where required, provide multiple tube supports to prevent tube sag.
- The fin-tube and header section shall float within the casing to allow free expansion of tubing.

- Suitable for 1380 kPa steam working pressure. Conform to the provisions of ARI 410. Certify coil capacities, pressure drops and selection procedures on accordance with ARI 410

H. FILTERS

1. Provide filters of the type indicated on the drawings and as specified in Section 15885, "Air Cleaning."

I. HUMIDIFIER:

1. Provide evaporative humidifier that uses steam from a boiler to create steam for humidification through the use of a heat exchanger. Humidifier shall be a UL listed.

2. Stainless Steel Construction: Vaporizing chamber, cover and fittings shall be constructed of stainless steel with heli-arc welded seams.

3. Cleanable design: Vaporizing chamber cover and or front cleanout plate shall be easily removable for access to the vaporizing chamber for removal of loose scale.

4. Heat Exchanger (non-deionized water): Constructed of stainless steel (tubes and headers) with welded joints and shall be Teflon® coated to allow continuous shedding of scale.

5. Steam Valve: Valve shall be a normally closed modulating type with modified linear flow characteristics, stainless steel trim, and actuator. Humidifier manufacturer shall furnish valve.

6. Steam Trap and Strainer: Humidifier shall be provided with a float and thermostatic trap and a steam supply line strainer.

7. The unit shall be supplied with a stainless steel dispersion assembly suitable to be installed inside the AHU, complete with calibrated orifice tubelets. Provide assembly for connection of humidifier and dispersion tube assembly.

8. Electronic Water Level Control: System shall provide for automatic refill and skimmer bleed-off functions. System shall consist of:

   a) A water level sensing unit comprised of three metallic probes screwed into a threaded probe head. Probe head shall incorporate probe isolation skirts to eliminate short-circuiting between probes caused by mineral coating of probe head.

   b) Probe head shall e mounted on the front of the vaporizing chamber.

   c) A solenoid operated fill valve shall be factory mounted on the front of the humidifier.

9. Surface Skimmer: Surface skimmer shall be provided which is field adjustable to provide for optimum mineral removal with minimum water waste.

10. Control Cabinet: Shall be UL/CSA listed JIC enclosure. Control devices shall be mounted on a sub-panel within the enclosure. Control devices shall include electronic water level control, control circuit transformer, numbered terminal strip, all internal wiring and electrical diagram.

11. The cabinet will be shipped loose and all interconnecting wiring between cabinet and humidifier shall be field supplied.

12. Microprocessor Control System: Shall be factory mounted and wired in the humidifier control panel with humidity sensors to be shipped loose for field installation. Mounting instructions and wiring diagram shall be included and provide the following features and functions:

    a. Water make up valve control and low water safety shutdown.

    b. Auto drain/flush sequence whereby microprocessor accumulates actual humidifying "ON" time, and activates auto drain/flush sequence.

    c. End of season drain function, which activates when there has been no demand for humidification over a 72-hour period.

    The alphanumeric digital display portion shall continuously scroll all system functions including:

    1) Actual room or space R.H.
    2) Humidistat set point R.H.
    3) Duct R.H. (in variable air volume applications)
    4) High limit humidistat set point R.H.
    5) Heater demand %
    6) "Time until service" message
    7) High limit and air flow proving circuit condition

    The keypad portion shall enable the user to reset or adjust the following functions:

    1) Humidistat R.H. setpoint
    2) Humidistat R.H. high limit setpoint (used with VAV package)
    3) Auto drain/flush frequency interval
    4) Auto drain duration
    5) Auto flush duration
    6) Throttling range adjustment
    7) Time to go until next auto drain/flush sequence

13. Factory Mounted Control Cabinet: Cabinet shall be factory attached to side of humidifier and all wiring between cabinet and humidifier shall be completed at factory.

14. Duct High Limit Humidistat: Compatible high limit modulating humidistat shall be shipped loose for field installation. Humidistat shall sense humidity level within the duct and protect against saturation of air stream.

15. Factory Insulation: Humidifier shall be covered with ¾" thick, rigid, foil faced fiberglass insulation. Insulation shall be covered with reinforced aluminum foil. All surfaces except front face panel shall be covered.

16. Unit shall be complete with two-position humidistat for on-off control, modulating electronic control valve, freeze protection aquastat and VAV control package. Unit shall be covered with 2-year warranty.

J. Mixing Damper: Provide mixing dampers of construction to conform to the requirements of Section 15950, "Automatic Control Systems."

1. Standard sized dampers will not be accepted.

2. Leakage rate shall not exceed 50 L/s per m^2 when closed at 250 Pa differential pressure.

PART 3 - EXECUTION

3.1 INSTALLATION OF AIR HANDLING UNITS

A. General: Install air-handling units where indicated on the drawings, in accordance with equipment manufacturer's published installation instructions.

B. Access: Provide access space around air handling units for service as indicated on the drawings, but in no case less than that recommended by the manufacturer.

C. Support: Install floor-mounted air handling units on 100 mm high concrete pad, 100 mm larger on each side than unit base.

D. Mounting: Mount air handling units with internal factory furnished isolators in accordance with manufacturer's instructions. Mount units scheduled for external isolators in accordance with Section 15240, "Vibration Isolation."

E. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted.

1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 16 sections.

F. Piping Connections: Provide piping, valves, accessories, gauges, supports, and flexible connections as indicated on the drawings. Locate freezestats and trap air handling unit drain-pan connections according to manufacturer's recommendations.

G. Duct Connections: Provide ductwork, accessories, and flexible connections as indicated on the drawings.

3.2 TESTING

A. General: Upon completion of installation of air handling units, start-up and operate equipment to demonstrate capability and compliance with requirements. Field correct malfunctioning units, then retest to demonstrate compliance.

3.3 EXTRA STOCK

A. Filters: Provide one extra set of filters for each air-handling unit. Install new filters at completion of air handling system work, and prior to testing, adjusting, and balancing work. Do not operate fans unless filters are in place.

B. Belts: Provide one spare set of belts for each belt-driven air-handling unit. Deliver to the

Contracting Officer's representative and mark with the air handling unit's number.

END OF SECTION 15855

SECTION 15860 - CENTRIFUGAL FANS

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Extent of centrifugal fan work required by this Section is indicated on the drawings and schedules, by the requirements of this Section, and Section 15010, "Mechanical Basic Requirements."

B. Types: Types of centrifugal fans required include:

1. Centrifugal fans

C. Related Sections: Refer to other Division 15 sections for the following:

1. Ductwork and Sheet Metal
2. Field Installed Controls and Interlock Wiring
3. Vibration Isolation
4. Meters and Gauges
5. Testing, Adjusting and Balancing
6. Air Conditioning and Air Handling Units

D. Other Divisions: Refer to other Division 16 sections for the following:

1. Power Wiring
2. Magnetic and Manual Starters Disconnect Switches

1.2 QUALITY ASSURANCE

A. Air Movement and Control Association, Inc. (AMCA): Provide centrifugal fans conforming to the requirements of AMCA 99 "Standards Handbook."

1. Test and rate fans in accordance with AMCA 210, "Laboratory Methods of Testing Fans for Rating Purposes."

2. Arrangement: Conform to fan and drive arrangements per AMCA 99-2404, "Drive Arrangement for Centrifugal Fans," and 99-2410, "Drive Arrangement for Tubular Centrifugal Fans."

3. Spark Resistant Construction: Conform to AMCA 99-0401, "Classifications for Spark-Resistant Construction."

4. Class Standards: Conform to AMCA 99-2408, "Operating Limits for Centrifugal Fans." Provide classes scheduled.

5. Rotation Discharge: Conform to AMCA 99-2406, "Designations for Rotation and Discharge of Centrifugal Fans."

6. Sound Rating: Conform to AMCA 300, "Reverberant Room Method for Sound Testing of Fans."

B. Current Models: Provide fans of the current, catalog product of the manufacturer.

C. Experience: Fans shall have been installed and used without modifications, renovation or repair, on other projects for not less than one year prior to the date of opening bids for this project.

D. Structural Members: Use structural sections listed in the latest edition of American Iron and Steel Institute (AISI). Factory formed sheet steel is not acceptable for structural members.

E. Commissioning Tests: Centrifugal fans shall meet commissioning requirements of Division 01 and paragraphs in Part 3 of this Section.

1.3 SUBMITTALS

A. Division 1: Conform to the requirements of Division l, Section 01003, "Submittals."

B. Product Data: Submit for review manufacturer's cataloged information including:

1. Material specifications.
2. Construction details.
3. Capacity ratings.
4. Fan performance curves indicating operating point.
5. Gages and finishes of materials.
6. Dimensional drawings.
7. Weight.
8. Accessories specified.
9. Motors and drives.

1.4 SPARE PARTS

A. Belts: Provide one new spare set of belts for each fan furnished under this Contract. Mark each belt assembly with associated fan number. Hang on an appropriate device, provided by the Contractor, on the utility room wall.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Handling: Handle fans and components carefully to prevent damage, denting and scoring.

B. Storage: Store fan components in a clean, dry place. Protect from weather, dirt, water, construction debris and physical damage.

C. Rigging: Comply with manufacturer's rigging and installation instructions.

D. Access: Verify building access limitations before delivery to the site.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (Not Used)

2.2 CENTRIFUGAL FANS

A. General: Provide centrifugal fans of quantities, sizes, arrangements and types as indicated on the drawings, as scheduled and specified.

B. Complete Fan Units: Provide factory designed, assembled and tested fans, each consisting of a housing, fan wheel, shaft, bearings, structural supports, motor, drive, belt guard and accessories specified or scheduled.

C. Meeting Room Ceiling Fan

Duct mounted exhaust fans shall be of the centrifugal, belt driven in-line type. The fan housing shall be of the rectangular design constructed of heavy gauge galvanized steel and shall include rectangular duct mounting collars.

A hinged panel shall be provided in the fan cabinet of sufficient size to permit access for service to all of the fan's internal components without dismantling the cabinet.

The fan wheel shall be of the galvanized steel, forward curved, centrifugal type. Wheels shall be dynamically and statically balanced.

Motors shall be of the heavy duty type with permanently sealed ball bearings. The wheel shaft shall be ground and polished steel mounted in permanently sealed pillow block bearings. Drives shall be sized for a minimum of 150% of driven horsepower. Pulleys shall be of the machined cast iron type, keyed and securely attached to the wheel and motor shafts. The motor pulleys shall be adjustable for final system balancing.

All fans shall bear the AMCA Certified Ratings Seal for air performance.

Fans shall be similar to Model BCF as manufactured by Greenheck or approved equal.

D. In-Line Return Air Fan (for AHUs)

Duct mounted return fans shall be of centrifugal belt driven in-line type. The fan housing shall be of the square design constructed of heavy gauge galvanized steel and shall include square duct mounting collars.

Fan construction shall include two removable access panels located perpendicular to the motor mounting panel. The access panels must be of sufficient size to permit easy access to all interior components.

The fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced.

Motors shall be heavy duty ball bearing type, carefully matched to the fan load and furnished at the specified voltage, phase and enclosure. Motors and drives shall be mounted out of the airstream. Motors shall be readily accessible for maintenance.

Precision ground and polished fan shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L50) life in excess of 200,000 hours at maximum cataloged operating speed.

Drives shall be sized for a minimum of 150% of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.

Motor pulleys shall be adjustable for system balancing. A NEMA 1 disconnect switch shall be provided as standard, except with explosion resistant motors, where disconnects are optional. Factory wiring shall be provided from motor to the handy box.

All fans shall bear the AMCA Certified Ratings Seal for both sound and air performance.

Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.

Fans shall be similar to Model BSQ as manufactured by Greenheck or approved equal.

E. Power Roof Ventilator (PRV)

Roof exhaust fans shall be centrifugal belt driven type. The fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced. The fan housing shall be constructed of heavy gauge aluminum with a rigid internal support structure. The fan shroud shall have a rolled bead for added strength.

Motors shall be heavy duty ball bearing type, carefully matched to the fan load, and furnished at the specified voltage, phase and enclosure. Motors and drives shall be mounted on vibration isolators, out of the airstream. Fresh air for motor cooling shall be drawn into the motor compartment from an area free of discharge contaminants. Motors shall be readily accessible for maintenance.

Drive frame assemblies shall be constructed of heavy gauge steel and mounted on vibration isolators. Precision ground and polished fan shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L50) life in excess of 200,000 hours at maximum cataloged operating speed. Drives shall be sized for a minimum of 150% of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts. Motor pulleys shall be adjustable for final system balancing.

A disconnect switch shall be factory installed and wired from the fan motor to a junction box installed within the motor compartment.

A fan conduit chase shall be provided through the curb cap to the motor compartment for ease of installation.

All fans shall bear the AMCA Certified Ratings Seal for sound and air performance.

Each fan shall bear a permanently affixed manufacturer's nameplate containing the model

number and individual serial number for future identification.

Fans shall be similar to GB as manufactured by Greenheck or approved equal.

F. Communication Rooms Ceiling Mounted Fan

Ceiling mounted exhaust fans shall be of the centrifugal direct drive type. The fan housing shall be constructed of heavy gauge galvanized steel. The housing interior shall be lined with 0.5 in. acoustical

PART 3 - EXECUTION

3.1 INSPECTION AND ACCESS

A. General: Inspect and verify the following items.

1. Verify access before fan delivery.
2. Verify structural supports and bases.
3. Confirm clearance, head room and arrangement before installation.

3.2 INSTALLATION OF CENTRIFUGAL FANS

A. General: Install centrifugal fans in accordance with the manufacturer's installation instructions, where indicated on the drawings.

B. Support Bases: Provide minimum 4-inch100 mm high concrete pad and concrete bases as indicated.

C. Isolation: Mount on vibration isolators specified.

D. Flexible Connections: Provide flexible connections.

E. Motor Connections: Provide flexible liquid tight motor connections.

F. Start-Up: Verify rotation; adjust belts, lubricate and start-up in presence of manufacturer's representative.

3.3 INSTALLATION OF POWER ROOF VENTILATORS

A. General: Install power roof ventilators where indicated on the drawings in accordance with manufacturer's installation instructions.

B. Coordination: Coordinate ventilator work with work of roofing and wall construction.

C. Ductwork: Connect ducts to ventilators in accordance with manufacturer's installation instructions and Section 15890, "Sheet Metal Ductwork."

1. Provide access door in duct below ventilator to service damper.
2. Solder bottom joints and up 2 inches (50 mm) of side joints of duct under roof ventilator to retain any moisture entering the ventilator.

D. Roof Curbs: Coordinate flashing and counter flashing of roof curbs with roofing system provided.

E. Start-Up: Verify rotation; adjust belts; lubricate and start-up in the presence of the manufacturer's representative.

3.4 COMMISSIONING TESTS

Meet with requirements of Section 01650, "Start-Up/Commissioning."

A. Preparation for Tests: Before the scheduled commissioning tests, the Contractor shall have prepared the centrifugal fans and the associated air handling systems (supply, return, and/or exhaust) in accordance with the contract requirements and ready for operation. All architectural openings and mechanical systems shall be in their normal operation positions during the tests.

B. Capacity Test: The fan system must be tested to deliver the specified capacity under the specified conditions as listed in the equipment schedule, on the drawings, or in the specifications. Requirements for air system test are specified in Division 15, Section 15990, "Testing, Adjusting, and Balancing."

END OF SECTION 15860

SECTION 15870 – CLASSROOM / SERVER AIR CONDITIONING UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Extent of computer room air conditioning unit work required by this Section is indicated on drawings and schedules, by requirements of this Section, and Section 15010, "Mechanical Basic Requirements."

B. Related Sections: Refer to other sections of Division 15 for the following:

1. Meters and Gauges.
2. Hydronic Piping Systems and Hydronic Specialties.
3. Testing, Adjusting, and Balancing.

C. Division 16: Refer to Division 16 for the following work:

1. Power Wiring.
2. Disconnects.

1.2 QUALITY ASSURANCE

A. Manufacturer: Provide computer room air conditioning units that are the standard product of an equipment manufacturer regularly engaged in the production of such units who issues complete catalog information on such products. Units shall not be field fabricated.

B. Certifications: Submit certified technical and test data indicating compliance with the capacities specified.

C. Codes and Standards: Provide computer room air conditioning units conforming to the following:

1. Air-Conditioning and Refrigeration Institution (ARI): Comply with ARI 410, "Forced-Circulation Air-Cooling and Air-Heating Coils."
2. Air Movement and Control Association, Inc. (AMCA): Comply with AMCA 210, "Laboratory Methods of Testing Fans for Rating Purposes."
3. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE): Construct and install refrigerant coils in accordance with ASHRAE 15, "Safety Code for Mechanical Refrigeration."
4. National Electrical Manufacturers Association (NEMA): Provide electrical components required as part of computer room air conditioning units, which comply with NEMA Standards.
5. National Fire Protection Association (NFPA): Comply with NFPA 70, "National Electrical Code" as applicable to installation and electrical connections of ancillary

electrical components of computer room air conditioning units.

6. Underwriters Laboratories, Inc. (UL): Provide electrical components required as part of computer room air conditioning units, which have been listed and labeled by UL.

D. Commissioning Tests: Computer room air conditioning units shall meet commissioning requirements of paragraphs in Part 3 of this Section.

1.3 SUBMITTALS

A. Division 1: Conform to the requirements of Division 1, Section 01003, "Submittals."

B. Product Data: Submit manufacturer's product data for air conditioning units showing dimensions, weights, capacities, ratings, fan performance with operating point clearly indicated, motor electrical characteristics, finishes of materials, and installation instructions.

C. Maintenance Data: Submit maintenance instructions, including instructions for lubrication, filter replacement, motor and drive replacement, and spare parts list. Include this data, product data, shop drawings, and wiring diagrams in maintenance manuals in accordance with requirements of Division 1.

1.4 DELIVERY, STORAGE AND HANDLING

A. Delivery: Deliver computer room air conditioning unit with factory-installed shipping skids and lifting lugs; pack components in factory-fabricated protective containers.

B. Handling: Handle computer room air conditioning units carefully to avoid damage to components, enclosures, and finish. Do not install damaged components. Replace damaged units with new units.

C. Storage: Store computer room air conditioning units in a clean, dry place and protect from weather and construction traffic.

D. Unloading: Comply with manufacturer's rigging instructions for unloading air handling units, and moving them to final location.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (Not Used)

2.2 AIR CONDITIONING UNITS (CHILLED WATER SYSTEM)

A. General: Provide air conditioning units of factory assembled packaged unitary type. Where up-flow units are specified, they shall have a directional discharge

plenum, with adjustable grille bars, and with multiple direction blow appropriate to the installation configuration.

B. Capacities: Provide air conditioning units of capacity and type as indicated on the drawings and schedules.

Cabinet and Frame Construction

The frame shall be constructed of MIG welded tubular and formed steel. All frame and internal fill components shall be coated using an Autophoretic® process to protect against corrosion. The panels shall be insulated with a minimum 1 in. (25.4 mm), 1-1/2 lbs. (0.68 kg) density fiber insulation. Front and side panels shall have captive, 1/4 turn fasteners. The cabinet shall be designed so that all components are serviceable and removable from the front of the unit.

Fan and Motor Section

The fan shall be the centrifugal type, double width, double inlet. The shaft shall be heavy duty steel with self-aligning ball bearings with minimum life span of 100,000 hours. The fan motor shall be 1750 RPM and mounted on an adjustable base. The drive package shall be sized for 200% of the fan motor horsepower, and equipped with an adjustable motor pulley. The fan/motor assembly shall be mounted on (vibration isolators) (solid base). The fan shall be located to draw air over the coil to ensure even air distribution and maximum coil performance.

High Efficiency Motor : The fan motor shall be high efficiency motor with a full load efficiency of 95%.

Filter

The filter shall be 3” in. (mm) thick and rated not less than 65% efficiency based on ASHRAE 52-76.

DDC Control

The system shall allow user review and programming of temperature setpoints, alarm parameters, and setup selections including choice of control type. The unit shall be operated in conjunction with the overhead VAV system via a common wall mounted thermostat. For sequences of operation refer to the design drawings.

Control: The control system shall allow programming of the following room conditions:

Temperature Setpoint 65-85°F (18-29°C)
Temperature Sensitivity +1 to +9.9°F (0.6 to 5.6°C) in 0.1° increments

System Auto-Restart

For start-up after power failure, the system shall provide automatic restart with a programmable (up to 9.9 minutes in 6-second increments) time delay. Programming can be performed from the central site monitoring system.

Chilled Water Flush Cycles

Chilled water coils shall be automatically flushed to prevent the buildup of contaminants. Systems without this feature shall include the necessary devices to bypass fluid into the coil on a programmed basis.

Alarms

The DDC shall activate an audible and visual alarm in event of any of the following conditions:

i. High Temperature
ii. Low Temperature
iii. Short Cycle
iv. Main Fan Overload
v. High Head Pressure
vi. Change Filter
vii. Loss of Air Flow
viii. Loss of Power
ix. Loss of Water Flow

Audible Alarm

The audible alarm shall annunciate any alarm that is enabled by the operator.

Common Alarm

A programmable common alarm shall be provided to interface user selected alarms with a remote alarm device.

Remote Monitoring

All alarms shall be communicated to the existing EMCS controls site monitoring system with the following information: date and time of occurrence, unit number,

and present temperature and humidity.

Floor Stand

The floorstand shall be constructed of a heliarc welded tubular steel frame. The floorstand shall be coated using an autodeposition process to protect against corrosion. The floorstand shall have adjustable legs with vibration isolation pads. The floorstand shall be 6in. high.

Plenum

The unit shall be supplied with a 3-way air discharge plenum. The plenum shall be 18 in. (457 mm) high and powder painted the same color as the room unit. Plenum shall be factory sound-attenuated with 1” sound lining.

Disconnect Switch, Non-Locking Type

The manual disconnect switch shall be mounted in the high voltage section of the electrical panel. The switch shall be accessible with the door closed.

Smoke Detector

The smoke detector shall immediately shut down the environmental control system and activate the alarm system when activated. The smoke detector shall be mounted in the electrical panel with the sensing element in the return air compartment.

Chilled Water Self Contained Systems

Chilled Water Coil

The coil shall be controlled by a modulating control valve. It shall be configured as an (V) frame and be constructed of copper tubes and aluminum fins and have a maximum face velocity of 500 ft. per minute and in capacities shown on the drawings schedules. The water circuit shall be designed to distribute water into the entire coil face area.

3-Way Chilled Water Valve (see floor plans)

The water circuit shall include a 3-way modulating valve where specifically shown as required on the design drawings. The DDC control shall position the valve in response to room conditions. Cooling capacity will be controlled by bypassing chilled water around the coil.

2-Way Chilled Water Valve

The water circuit shall include a 2-way modulating valve. The DDC control shall position the valve in response to room conditions.

Flow Switch

The flow switch shall activate the alarm system should the chilled water supply be interrupted. The switch shall be factory mounted and wired.

Electrical Wiring: Provide all electrical circuits in conformance with NFPA 70 and color coded for ease in field tracing.

2.3 AIR CONDITIONING UNIT (DUAL COOLING SOURCE SYSTEM)

A. General: Specification requirements outlined under paragarph "2.2 Air Conditioning Units (Chilled Water System)" are applicable to their entirety. The following paragraphs outline the additional characteristics and requiremnts for the Dual cooling source unit. The dual cooling source system shall consist of an air or water cooled compressorized system with the addition of a chilled water coil, a modulating control valve, and a comparative temperature sensor. The system shall be able to function either as a modulating chilled water system or as a compressorized system, or a combination of both. The primary mode of cooling shall be chilled water. Switchover between the two cooling modes shall be performed automatically by the microprocessor control.

B. DDC Control

Compressor Short-Cycle Control
The control system shall include a program to prevent compressor short cycling.

Automatic Compressor Sequencing
The microprocessor shall automatically change the lead/lag sequence of the compressors after each start to lengthen compressor-on cycles and even compressor wear.

Sequential Load Activation
During start-up, or after power failure, the microprocessor shall sequence operational load activation to minimize inrush current. Systems allowing multiple loads to start simultaneously are unacceptable.

Front Monitor Display Panel

The microprocessor shall provide a front monitor LCD backlit display panel with 4 rows of 20 characters with adjustable contrast. This display (along with five front mounted control keys) shall be the only operator interface required to obtain all available system information such as room conditions, operational status, alarms, control and alarm setpoints, and all user selections including alarm delays, sensor calibration, DIP switch selections, and diagnostics. All indicators shall be in language form. No symbols or codes shall be acceptable.

C. Compressorized System (Indoor Unit)

Dual Refrigeration System
Each refrigeration circuit shall include hot gas mufflers, liquid line filter dryers, refrigerant sight glass with moisture indicator adjustable, externally equalized expansion values, and liquid line solenoid valves.

Semi-Hermetic Compressors
The compressors shall be located in a separate compartment so they may be serviced during operation of the equipment. The compressor shall be semi-hermetic with a suction gas cooled motor, vibration isolators, thermal overloads, oil sight glass, manual reset high pressure switch, pump down low pressure switch, suction line strainer, reversible oil pumps for forced feed lubrication and a maximum operating speed of 1750 RPM.

Four-Step Refrigeration System
The unit shall include cylinder unloaders on the semi-hermetic compressors. The unloaders shall be activated by solenoid valves which are controlled from the microprocessor control. In response to the return air temperature, the microprocessor control shall activate the unloader solenoids and the liquid line solenoids such that four stages of refrigeration cooling are obtained. The stages shall be:

1) one compressor, partially loaded,
2) two compressors partially loaded,
3) one compressor partially loaded, one compressor fully loaded,
4) two compressors fully loaded. On a call for dehumidification, the microprocessor control shall insure that at least one compressor is on full for proper humidity control.

A-Frame DX Coil
The evaporator coil shall be an A-Frame design of capacity and characteristics shown on the project design documents schedules. Refrigerant of each system shall be distributed throughout the entire coil face area. A stainless steel condensate drain pan shall be provided.

D. Air Cooled System (Outdoor Unit)

The air cooled condenser shall be the low profile, show speed, multiple direct drive, propeller fan type. The condenser shall be constructed of aluminum and contain a copper tube, aluminum fin coil arranged for vertical air discharge.

Fan Speed Control Condenser
The winter control system for the air cooled condenser shall be Liebert Fan Speed Control. The variable speed motor shall operate from 0 to 230 volts single phase, 10 to 1050 RPM. It shall be designed with ball bearings, permanent lubrication, internal overload protection, 40°C rise at full speed, 65°C rise at 10 RPM. The control system shall be complete with transducers, thermostats and electrical control circuit, factory prepackaged in the integral condenser control box. The transducer shall automatically sense the highest head pressure of either operating compressor and control the variable speed fan on the air cooled condenser to properly maintain the head pressure. The fan speed control system shall provide positive start-up and operation in ambient temperature as low as –20°F (–28.9°C).

Winter Control System
The winter control system for the air cooled condenser shall start-up and positive head pressure control with ambient temperatures as low as -30°F (-34.4°C). The package shall include the following components for each refrigeration circuit: insulated receiver, pressure relief valve, head pressure three-way control valve, and rotalock valve for isolating the refrigerant charge. The receiver shall be factory insulated and mounted ready for the field connection to the air cooled condenser. The heater shall require a separate power, single phase.

Air Cooled Condenser Disconnect Switch:
Provide a disconnect switch factory mounted and wired to the condenser control panel, accessible from the exterior.

E. Dual Cooling Source System Unit additional characteristics

Dual Cooling Source Three-Way Control Valve
The water circuit shall include a 3-way modulating valve. The microprocessor positions the valve in response to room conditions. Cooling capacity will be controlled by bypassing chilled water around the coil. The modulating valve travel for dehumidification shall be proportional.

Dual Cooling Source Coil
The dual-cooling source coil shall be constructed with copper tubes and aluminum fins. It shall be located in the return air, before the A-Frame evaporator coil. The dual cooling source coil shall be of the capacity shown on the project design drawing schedules.

PART 3 - EXECUTION

3.1 AIR CONDITIONING UNIT INSTALLATION

A. General: Install air conditioning units where indicated on the drawings in accordance with equipment manufacturer's published installation Instructions.

B. Access: Provide access space around the air conditioning units for service but in no case less than that recommended by the manufacturer.

C. Electrical Wiring: Install electrical devices furnished by manufacturer but specified to be factory-mounted. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 16 sections.

D. Piping Connections: Provide piping, valves, accessories, gauges, supports, and flexible connections as indicated on the drawings. All isolation valves, 2-way and 3-way modulating valves and accessories shall be concealed within the cabinet of the unit. Unit piping connection shall take place from the chilled water piping system at the ceiling of the floor bellow the unit. Coordinate final location of the unit(s) with the user prior to core-drilling. All units shall be provided with 2-way valves except the last in the loop which will be provided with 3-way diverting valve to allow for chilled water loop circulation (see also design drawings).

E. Field Quality Control: Start up mainframe coolant units in accordance with manufacturer’s start up instructions. Test controls and demonstrate compliance with requirements. These specifications describe requirements for a computer room environmental control system. The system shall be designed to maintain temperature and humidity conditions in the rooms containing electronic equipment. The manufacturer shall design and furnish all equipment to be fully compatible with heat dissipation requirements

3.2 START-UP

A. General: Start and adjust all units installed under this specification under the supervision of an authorized factory trained representative of the manufacturer of each unit. Perform operational checks to make certain that controls and safety devices and systems are operating properly. If defects or improper adjustments are found, they shall be corrected and tests repeated.

1. An operational check shall be made to demonstrate compliance with contract requirements, including but not limited to, capacity and control accuracy.

2. A report, signed by each factory representative, shall be submitted showing test conditions and results.

END OF SECTION 15870

SECTION 15885 - AIR CLEANING

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Extent of air cleaning work required by this Section is indicated on the drawings and schedules, by requirements of this Section, and Section 15010, "Mechanical Basic Requirements."

B. Types: Types of air cleaning equipment specified in this Section include the following:

1. Replaceable air filters.
2. Extended surface air filters.
3. Side servicing housings.
4. Filter gauges.

C. Related Sections: Refer to other sections of Division 15 for the following:

1. Air Handling Units Factory Fabricated.
2. Ductwork.
3. Heating and Cooling Terminal Units.
4. Air Terminal Units.
5. Air Inlets and Outlets.
6. Testing, Adjusting, and Balancing.

D. Division 16: Refer to sections of Division 16 for the following:

1. Power supply wiring from power source to power connection on air filter units.

2. Control wiring between field-installed controls, indicating devices, and air filter unit control panels.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Provide air-cleaning equipment conforming to the following:

1. Air-Conditioning and Refrigeration Institution (ARI): Comply with provisions of ARI 850, "Commercial and Industrial Air Filter Equipment," pertaining to test and performance of air filter units.

2. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE): Comply with provisions of ASHRAE 52, "Method of Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter."

3. National Fire Protection Association (NFPA): Comply with applicable portions of NFPA pertaining to installation of air filters and associated electric wiring and equipment, including:

a. 70 National Electrical Code.

b. 90A Standard for the Installation of Air Conditioning and Ventilating Systems.

4. Underwriters Laboratories, Inc. (UL): Comply with UL standards pertaining to safety and performance of air filter units including:

a. 586 High-Efficiency, Particulate, Air Filter Units.
b. 900 Test Performance of Air Filter Units.

B. Certification: Submit test reports from an approved independent testing laboratory for each particulate type of filter to be furnished and certify that all filters to be furnished on the project are identical in performance and construction to the filters tested and are furnished with the identical media.

1. All filters shall have been procured by the testing laboratory on the open market independent of the filter manufacturer and the test reports shall indicate the method of procurement.

2. The test method shall be as described in ASHRAE 52.

C. Commissioning Tests: Air cleaning equipment shall meet commissioning requirements of paragraphs in Part 3 of this Section.

1.3 SUBMITTALS

A. Division 1: Conform to the requirements of Division 1, Section 01003, "Submittals."

B. Product Data: Submit manufacturer's technical product data including, dimensions, weights, required clearances and access, flow capacity including initial and final pressure drop at rated air flow, efficiency and test method, fire classification, and installation instructions.

C. Shop Drawings: Submit manufacturer's shop drawings for filter rack assemblies [and air washers] indicating dimensions, materials, and methods of assembly of components.

D. Samples: Submit one sample filter cartridge for each type of filter required, in accordance with requirements of Division 1.

E. Maintenance Data: Submit maintenance data and spare parts lists for each type of filter, rack [and air washer] required. Include this data, product data, shop drawings, and wiring diagrams in maintenance manual; in accordance with requirements of Division 1.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Handle air-cleaning equipment to prevent damage. Do not install damaged air cleaning equipment; replace with new.

B. Storage: Store air-cleaning equipment in a clean, dry place.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (Not Used)

2.2 AIR FILTERS, GENERAL

A. Air By-Pass: Construct filters so as to prevent the passage of unfiltered air. Provide felt, rubber, or neoprene gaskets, or other permanent means, to prevent air bypass between filter frames and supporting members (housing and casings) when the filter efficiency is above 40 percent.

B. Finish: Protect steel filter parts against corrosion with a baked on enamel, epoxy resin, polyvinyl coating, zinc-coating, cadmium plating, two coats of oil paint, two coats of lacquer, or coat with alkyd paint after phosphate cleaning.

C. Identification: Provide each filter with an identification device mounted in a location where it will be visible after installation; show model number and all other data necessary for ordering renewal media. Provide a separate plate with the foregoing information as well as serial number on each automatic roll type filter.

D. Supports: If required, provide supports (screen, grid, or frame type) for filters adequate to position the media for uniform air distribution without tearing, and to prevent excessive motion and deflection under varying airflow conditions.

E. Replacement Filters: Provide all replacement filters and filter media that are the same as specified hereinafter for the applicable type filter.

2.3 REPLACEABLE THROWAWAY (TYPE A) FILTERS

A. General: Provide replaceable throwaway filters that are dry or viscous coated flat panel type, 2 inches (50 mm) thick with throwaway frames and media

1. Holding frames shall be provided for each filter, fabricated from not less than 20 gauge1 mm galvanized steel.

2. Frames shall be provided with suitable devices for holding filter panels in place and gasket to prevent air bypass.

3. Each filter when operated at rated face velocity 350 fpm (1.8 m/s) and tested in accordance with ASHRAE 52 shall have an initial resistance not greater than 0.15 IWG (37 Pa), final rated resistance of 1 IWG (250 pa) and average arrestance of 90 percent, and an average efficiency not less than 25 percent per ASHRAE 52.

2.4 EXTENDED SURFACE (TYPE B) FILTERS

A. General: Provide extended surface filters that are cartridge type consisting of dry or viscous coated fibrous media formed into pockets or V-shaped pleats supported by wire frames, air inflated or self supporting. Provide media that is UL listed as Class 1 or 2 material.

B. Holding Frames: Provide holding frames that are factory fabricated of minimum 18 gauge (1.3

mm) galvanized steel and provided with suitable holding devices and gasketing to retain filter elements securely in place and prevent bypass unfiltered air between or around filter elements.

1. Frames shall be designed for bolting or riveting together into built up filter banks.

2. Assembled filter banks shall be guaranteed not to bypass unfiltered air between or around filter cartridges and provide completed filter bank assemblies designed for side servicing of filters.

C. Side Service Housing: In lieu of an assembled filter bank, a side servicing housing may be used for systems where the filter bank is no more than 6 feet (1.8 m) high and 10 feet (3 m) wide.

1. The side service housing shall be a complete factory-assembled housing with upstream and downstream flanges for insertion into the ductwork system as indicated on the plans.

2. The housings shall be manufactured of suitably reinforced heavy gauge galvanized steel.

3. The unit shall be provided with integral prefilter tracks to accommodate 2-inch (50-mm) throwaway or cleanable prefilters.

4. Access doors with continuous gasketing on the perimeter and positive locking devices shall be provided at both ends of the housing. When an access door is opened, the filter cartridges shall be slid into the housing where they shall be retained on slide channels.

5. These channels shall incorporate a positive-sealing gasket material to seal the top and bottom of the filter-cartridge frames to prevent bypass.

6. Leakage shall be prevented between cartridges, and between cartridges and doors, by factory-installed gasketing.

7. Filter cartridges shall be capable of being loaded or unloaded through either access door.

D. Prefilters: Where indicated on drawings, provide the assembled bank of extended surface filters with prefilters which shall be replaceable throwaway flat panel type as hereinbefore specified for Type A. Design upstream servicing holding frames accommodating both prefilters and extended surface filters so that the prefilters can be changed without disturbing the surface filter.

E. Ratings: Provide filters with rated face velocity of 2.5 m/s, initial resistance of 75 Pa with 65 percent ASHRAE 52 efficiency, and 150 Pa with 90 to 95 percent efficiency, and final rated resistance of 300 pa

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install air filters and holding devices of types indicated, and where shown on the drawings. Install air filters in accordance with air filter manufacturer's written instructions and with recognized industry practices to ensure that filters comply with requirements and serve

intended purposes.

B. Filter Element and Media Protection: Protect filter elements and media against dirt during construction, and do not operate until system is thoroughly cleaned.

1. Filters must be in regular operating condition before the fans to which they are connected are operated for any purpose, such as temporary ventilation or adjusting.

2. After all adjustments are completed and immediately before panel filters are accepted for regular operation, they shall be cleaned or provided with additional new media to put them in "new" condition including full rolls of media for automatic roll type filters.

3. Extended service cartridge filters shall not be installed until the system is ready for balancing.

4. Prefilters shall be used alone or temporary panel filters will be used in place of the extended surface filters.

C. Wiring: Provide and install filter wiring in accordance with the requirements of UL 73, "Motor-Operated Appliances," and NFPA 70, "Wiring in Ventilation Ducts."

D. Filter Gauges: Provide and install a gauge of the diaphragm actuated, dial and pointer type, or inclined draft type, graduated to read from 0-inch to 2-inch W.G.,(0 Pa to 500 Pa), near each filter on apparatus control panels.

1. The gauge shall be connected to pressure tips of approved design on each side of filters, and shall correctly indicate the air pressure drop through the filter.

2. Connections shall be made with copper or aluminum tubing and shall be provided with cocks for checking calibration.

3. Inclined gauges shall be carefully leveled and adjusted.

4. Where filter bank capacity does not exceed 5000 cfm, (2500 L/s), a mechanical indicating device may be used, which gives a distinct visual signal when the filter pressure drop exceeds a predetermined value. Means for resetting the indicator shall be on the outside. The device shall be connected to pressure tips and shall be adjusted to operate at approximately 0.5-inch W.G. (125 Pa.) Plugged tappings for attachment of a draft gauge shall be provided.

3.2 COMMISSIONING TESTS

A. General: Operate installed air filters demonstrate compliance with requirements. Check all edges of filters and frames for air leakage of unfiltered air while system is operating. Correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise remove and replace with new units, and proceed with retesting.

END OF SECTION 15885

SECTION 15890 - DUCTWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Extent of ductwork is indicated on the drawings, in schedules, by requirements of this Section, and Section 15010, "Mechanical Basic Requirements."

B. Types: Types of ductwork systems and items required for this project include the following:

1. Rigid supply, returns and exhaust ductwork.
2. Flexible ductwork.
3. Plenums and casings, field erected.
4. Fire dampers.

C. Related Sections: Refer to other Division 15 sections for:

1. Exterior Duct Insulation.
2. Vibration Control.
3. Testing, Adjusting and Balancing.
4. Registers and Grilles.
5. Fire Stopping Around Dampers and Openings.

1.2 QUALITY ASSURANCE

A. National Fire Protection Association (NFPA): Conform to NFPA 90A "Standards for the Installation of Air Conditioning and Ventilating Systems."

B. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA): Provide ductwork systems in conformance with "HVAC Duct Construction Standards - Metal and Flexible," latest edition.

C. Alternatives: The SMACNA standards and publications referenced in this Section of the specifications establish ductwork construction requirements.

1. Alternatives to these standards and publications may be submitted. Approval will be based on demonstration that such alternatives are equivalent and satisfy the functional requirements described in the referenced standards.

2. Such demonstration shall include evidence that the alternatives proposed were tested in accordance with SMACNA procedures and with test results certified by an independent testing laboratory.

1.3 SUBMITTALS

A. Division 1: Refer to Section 01003, "Submittals."

B. Shop Drawings: Provide shop drawings of sheet metal ductwork as follows:

1. Draw to a scale not less than 1/4-inch to one foot (1:50).
2. Provide sheet sizes equal to Contract Drawings.
3. Show duct sizes, where possible use even duct sizes.
4. Show fitting details.
5. Show lighting and ceiling diffusers.

C. Shop Drawings for Field Erected Casings: Submit shop drawings for air handling unit casings, and plenums:

1. Draw to scale of 1/2-inch to 1 foot, (1:20), with sheet size equal to Contract Drawings.

2. Show plan, sections, elevations and details of all joints and casings.

3. Detail access doors and hardware.

4. Detail coil, damper, humidifier, filter and fan installations. Provide access doors.

D. Coordinated Shop Drawings: Provide coordinated shop drawings for sheet metal work in mechanical equipment rooms, and other congested areas listed.

1. Draw to a scale of 1/2-inch to 1-foot (1:20).

2. Provide sheet sizes to match Contract Drawings.

3. Show duct sizes.

4. Show bottom duct elevations from finished floor.

5. Show lighting, equipment, piping, columns and beams, with mounting heights.

6. Show construction details of all fittings.

7. Show construction details of plenums and casings.

E. Floor Plans: Provide sheet metal floor plans drawn to the same scale as the Contract Drawings.

1. Use Contract Drawing sheet size.

2. Show on each floor plan the floor penetrations, fire dampers and access doors, ducts with sizes and bottom elevations, terminal types and air quantities.

F. Certifications: Provide a duct schedule, certified by an officer of the sheet metal fabrication subcontractor, that the ductwork conforms to SMACNA standards, and for each sheet metal system furnished on the project include:

1. System name.
2. Duct system design pressure.

3. Duct Work
4. Duct gauge.
5. SMACNA rectangular reinforcement number.
6. SMACNA intermediate reinforcement number.
7. SMACNA transverse reinforcement number.
8. Rod diameter and type.
9. Sealant type.
10. Attachment method.

G. Field Manual: Submit one copy of the SMACNA "HVAC Duct Construction Standards-Metals and Flexible." Maintain a second copy on the project site.

1.4 MARKING AND STORAGE

A. Marking: Mark each section of ductwork delivered to the project site with a unique section number indicated on the shop drawings.

B. Storage: Store ductwork under roof. Ductwork stored outdoors and exposed to the weather shall be removed from the project site, cleaned or replaced with new.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (Not Used)

2.2 MATERIALS

A. Sheet Metal: Unless otherwise specified or indicated, construct ductwork from galvanized sheet steel conforming to American Society for Testing and Materials (ASTM) A 527/A 527M, "Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality," lock forming quality and ASTM A 525, "Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process," G90 zinc-coated.

1. Sheet steel shall be mill phosphatized, where exposed to outdoor weather.

B. Ductliner: Where indicated provide lined ductwork. Provide a liner of fiberglass with erosion proof face, conforming to Thermal Insulation Manufacturers Association (TIMA) AAC-101. Provide thickness indicated.

1. Attach liner with adhesive and fasteners. See paragraph "Ductliner Fasteners," of this Section.

C. Ductliner Adhesive: Conform to Adhesive Sealant Council (ASC) ASC-A-7001.

D. Duct Sealants: Provide sealants with a maximum 25 flame spread, and maximum 50 smoke in the dry state, conforming to ASTM E 84, "Standard Test Method for Surface Burning Characteristics of Building Materials," and fire resistive and non-flammable in accordance with ASTM D 93, "Standard Test Methods for Flash Point by Pensky-Martens Closed Tester," when wet.

E. Duct Tape: The use of duct tape is not permitted.

2.3 FABRICATION:

A. Shop Fabrication: Shop fabricate ductwork in conformance with SMACNA, "HVAC Duct Construction Standards-Metal and Flexible."

1. Conform to SMACNA requirements for metal thickness, reinforcing, joints, and sealing for maximum static pressures indicated on the drawings. Except where otherwise indicated on the drawings, construct ductwork as follows:

2. Construct supply ductwork for 3 inches (750 Pa) static pressure.

3. Construct return ductwork for 2-inch (500 Pa) negative static pressure.

4. Construct exhaust ductwork for 2-inch (500 Pa) negative static pressure.

5. Construct field erected casings for 4 inches (1000 Pa) negative and positive static pressure.

B. Elbows: Conform to SMACNA and the following:

1. Provide long radius type with centerline radius minimum 1.5 by duct width.

2. Provide short radius or square elbows where indicated or where required to fit restricted spaces.

3. Provide vanes on all short radius elbows.

4. Provide double thickness turning vanes on square elbows.

5. Conform to SMACNA for the number of vanes for fittings.

C. Parallel Flow Branches: Provide long radius takeoffs at parallel flow branches or square elbows where indicated.

D. Branch Connections: Provide radius, 45-degree entry or conical taps.

E. Butt Taps: Butt taps are not permitted.

F. Offsets and Transitions: Conform to SMACNA.

G. Obstractions: Conform to SMACNA.

H. Remote Heating and Cooling Coils: Conform to SMACNA.

I. Duct Access Doors: Conform to SMACNA with piano hinges, two sash locks and door gaskets.

1. Screwed access panels are not permitted.
2. Provide where indicated or where recommended by SMACNA.

J. Volume Dampers: Provide volume dampers where indicated and construct as follows:

1. Provide single blades to a maximum of 10-inch (250-mm) blade width.

2. Provide inside end bearings and locking quadrants with wing nuts.

3. Friction locks are not permitted.

4. Break damper blades on both edges for stiffness.

5. Provide multi-blades on dampers 12 inches (300 mm) and larger with inside pins and bronze bearings, and 2 inches (50 mm) wide by 1/8-inch (3 mm) thick structural galvanized channel frame.

6. Provide galvanized connecting bar with bronze bearings on multi-blade dampers.

K. Flexible Connections To Fans: Provide flexible connections on the discharge of all fans and on the inlets to S.W.S.I. fans.

1. On fans with slip inlets and outlets provide hemmed, 18 gauge (1.3 mm) connector sleeves screwed 8 inches (200 mm) on center.

2. On fans with flanged inlet and outlet connections, provide structural companion flanges, bolted to 16 gauge (1.5 mm) flexible connection sleeves, 6 inches 150 mm on center.

3. Provide sealant between flanges.

2.4 FLEXIBLE DUCTWORK:

A. Construction: Provide ductwork conforming to UL 181, "Factory-Made Air Ducts and Connections," Class I, and NFPA 90A where indicated on the drawings and as follows:

1. Maximum length from take-off to air outlet shall be 8 feet. (2400 mm).

2. Maximum one 90 degree bend in any length.

3. Provide continuous length with no intermediate joints.

4. Connect each end with stainless steel screw operated drawbands.

5. Support clear of the ceiling tile, light fixtures and air terminals.

6. Insulate with minimum 1 inch thick, 1.5 pound per cubic foot (25 mm thick, 24 $kg/m^{3)}$ fiberglass.

7. Sheath insulation with reinforced vapor barrier having a permeance not

exceeding 0.3 (17) per ASTM E 96, "Standard Test Methods for Water Vapor Transmission of Materials," Procedure A, and a puncture resistance not less than 50 Beach units per ASTM D 781.

8. Support for maximum sag of 1/2 inch (13 mm).

9. Provide duct with UL labels visible every 72 inches (300-mm) indicating conformance to UL 181.

2.5 FIRE DAMPERS

A. Standards: Provide fire dampers conforming to the requirements of NFPA 90A and UL listed, labeled and rated 1-1/2 hours. Provide fusible links 74 degrees C, vibration proof and secured with clinched "S" hooks or stainless steel bolts and lock nuts.

B. Access Doors: Provide access doors adjacent to all fire dampers.

2.6 PLENUMS AND CASINGS

A. SMACNA: Construct casings and plenums in conformance with SMACNA.

B. Minimum Pressure Class: Unless otherwise indicated construct plenums and casings to withstand either a negative or positive static pressure of 3 IWG (750 Pa).

C. Single-Wall: Provide single-wall field-erected air-handling units, casings and plenums where indicated on the drawings.

1. Construct in accordance with SMACNA Standards.

2. Use steel-angle-reinforced standing-seam construction.

3. Locate intermediate bracing angles bolted to the casing 24 inches (600 mm) on centers.

4. Construct for static pressure indicated or for the maximum fan static pressure whichever is less.

5. Bolt to 3 inches (75 mm) high concrete pads using 1-1/2 inches by 1-1/2 inches by 1/4 inch (40 mm by 40 mm by 6 mm) thick galvanized steel structural sections.

D. Double-Wall Casings for Plenums and Air Handling Units: Provide where indicated on the drawings, constructed as follows:

1. Provide 4 inches (100-mm) thick prefabricated double wall insulated metal panel assemblies, with 16 MS gauge (1.5-mm) aluminum or 18 gauge (1.3 mm) minimum galvanized steel outer sheets.

2. Provide 22 gauge (0.85 mm) Type 304 stainless steel inner sheets.

3. Casings shall be fully metal enclosed, insulated with 4 inches (100-mm) thick rigid glass fiber insulation and conforming to NFPA 90A, with maximum flame spread of 25 and maximum smoke developed of 50.

4. Field or factory fabricate to size and configuration indicated on the drawings, using field verified dimensions.
5. Prepare coordinated shop drawings. Refer to paragraph "Submittals," of this Section.

6. Provide joint sealants of mastic and bolt airtight.

7. Reinforce spans 10 feet (3 m) or greater with structural steel sections to yield maximum deflection 1/4 inch (6 mm) at minus 10 inches (2500 Pa) or plus 10 inches (2500 Pa) pressure.

8. Provide openings and doors, all factory framed, and reinforced with 304 stainless steel structural sections.

9. Construct doors of same material as casings, of sizes and locations indicated on the drawings but not smaller than 18 inches by 54 inches (450 mm by 1400 mm), and conforming to SMACNA.

10. Provide doors, hinges and hardware factory fabricated and mounted.

11. Doorswing shall open against air pressure, with door latches operable from either side.

12. Provide door seals with neoprene gaskets, which have an airtight seal.

13. Provide each door with a 10 inches by 10 inches (250 mm by 250-mm) wire reinforced double pane window.

14. Bolt base channel to 3 inches (75-mm) high concrete pads.

2.7 ACCESS DOORS

A. Standard: Provide access doors in conformance with SMACNA.

B. Location: Provide access doors in casings, plenums, and ducts where shown on the drawings and where specified for ready access to operating parts including fire dampers, smoke dampers, valves, and concealed coils.

C. Pressure Clarification: Construct and install access doors in accordance with SMACNA Standards to suit the static pressure classifications and the locations where installed.

D. Access Doors in Ducts: Provide and size doors as follows:

1. Minimum 24 inches by 24 inches (600 mm by 600 mm) clear opening.

2. When field conditions require an access opening smaller than 16-inch by 12-inch,

(400 mm by 300 mm), provide a 24-inch (600 mm) long removable section of casing or duct, secured with quick acting locking devices, 6 inches (150 mm) on centers, to permit ready access without dismantling other equipment.

E. Door Requirements: Provide doors in casings and duct as follows:

1. Arrange doors so that system air pressure will assist closure and prevent opening when the system is in operation.

2. Coordinate doors and equipment to provide unrestricted passage through clear door opening, without removal of any equipment.

3. Where pressure regulating dampers are installed in ducts or plenums, provide access doors with a clear wire glass observation port, 6-inch by 6-inch (150 mm by 150 mm) minimum size. Anchor port with structural metal frame, resilient gaskets and stainless steel bolts.

4. Hinges for doors in zinc coated or aluminum construction shall be steel or iron, zinc coated with brass pins.

5. Hinges for doors in copper, copper nickel alloy construction shall be all brass.

2.8 FLEXIBLE CONNECTIONS

A. Fans: Provide flexible connections between fans and ducts or casings where indicated on the drawings or required to accommodate expansion and vibration.

B. Material: Construct connections of cotton duck, minimum 20 ounces per square yard. (680 $g/m^{2)}$.

C. Elevated Temperature: For temperatures in excess of 100 (38C) degrees C, and corrosive, acid alkali or garage exhausts use close woven glass cloth, double neoprene coated, minimum 28 ounces per square yard. (1000 $g/m^{2)}$.

D. Length: Limit flexible connections to 4-inch (100-mm) active length in the direction of airflow.

E. Standard: Construct in accordance with SMACNA Standards.

F. Attachment: Attach to fans, casings and ductwork as hereinbefore specified.

PART 3 - EXECUTION

3.1 PREPARATION

A. Mock-Up: After approval of shop drawings construct a test portion of ductwork as follows:

1. Include a portion of main duct, a branch duct, five transverse joints, typical fitting connections, typical duct supports, and one access door.

3.2 INSTALLATION

A. Cleaning: Clean and pretreat surfaces before application of sealant.

1. Conform to the manufacturers cleaning procedures.

2. Install sealants in conformance with manufacturers' instructions.

B. Powder Actuated Fasteners: Powder actuated fasteners shall not be used to support rectangular ducts over 40-inch (1000-mm) maximum dimension.

C. Hangers: Hangers and supports shall conform to SMACNA section, "Hangers and Supports." Nail inserts, hangers and supports to formwork before slabs are poured. Cut off or remove nails, strap- ends and other projections, flush with concrete after forms are removed.

D. Vertical Risers: Support vertical ducts, passing through floors with two continuous angles screwed to the duct and bearing to the floor and conforming to SMACNA, "Riser Support-From Floor." Blocking or shimming ducts will not be permitted.

E. Fire Separation: Vertical ducts or horizontal ductwork penetrating fire rated walls and floors shall be fire separated with UL listed and labeled fire dampers.

1. Provide additional fire dampers indicated on the drawings.
2. Firestop between damper frames and fire walls.

F. Fittings: Provide fittings shown on approved shop drawings.

1. Offsets, transitions, remote coils, equipment, and field changes shall conform to SMACNA.

2. Butt taps and safing will not be permitted.

3. Bolt flanged equipment to ductwork with companion flanges.

G. Concrete Pads: Provide poured in place, minimum 3-inch (75-mm) high, concrete pads under floor mounted air-handling units. Construct pads of 3000 pound (20700 kPa) 28 day cure concrete.

3.3 FIELD QUALITY CONTROL

A. Segments: Install duct systems in segments of 10,000 square feet (1000 $m^{2)}$ or one floor area whichever is smaller.

1. Do not insulate or conceal before inspection by the Contracting Officer representative.

2. Remove insulation and ceilings to permit inspection.

3. Allow sealants to cure.

4. Leak test in accordance SMACNA, "HVAC Air Duct Leakage Test Manual" at 150 percent of maximum working pressure.

5. Provide orifice meter calibrated by an independent testing laboratory. Submit certificate of calibration. Certificate shall be valid for six months.

6. Provide orifice plates factory calibrated with stamped serial number, and furnish certified calibration curve.

B. Leak Test: Perform leakage test as required by Section 01650, "Start-Up/Commissioning."

1. Provide test fans, orifices, temporary power and instrumentation in accordance with SMACNA testing specifications.

2. Perform leak tests in accordance with SMACNA standards and record data. If leak test falls within specified limits, then this portion of ductwork shall serve as a standard of quality for the remainder of the project.

C. Leakage: Leakage shall not exceed [2] percent of maximum system air quantity indicated in the schedules.

D. Testing and Balancing: Acceptance of duct systems shall be contingent upon conformance with the requirements specified in Section 15990, "Testing, Adjusting And Balancing."

3.4 ADJUSTING AND CLEANING

A. Cleaning: Clean the inside of casings, fan scrolls, plenums, and accessible ductwork before starting fans.

1. Blowout coils with compressed air.

2. Install specified filters.

3. Proceed with testing and balancing.

4. Upon completion and acceptance of testing and balancing or after 200 hours operation whichever is greater, replace all filter media with new.

B. Set Dampers: Lock damper rods or splitter dampers.

1. Bend 2 inches (50 mm) from the bushing, and provide a 3 inch (75 mm) long handle.

2. Cut off balance of rod.

3. File or grind smooth.

END OF SECTION 15890

SECTION 15935 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Extent of air terminal unit work required by this Section is indicated on drawings and schedules, by requirements of this Section, and Section 15010, "Mechanical Basic Requirements."

B. Types: Types of air terminal units specified in this Section include the following:

1. Variable Air Volume Units.

C. Related Sections: Refer to other sections of Division 15 for the following:

1. Meters and Gauges
2. Mechanical Insulation.
3. Hydronic Piping Systems and Hydronic Specialties.
4. Steam and Condensate Piping and Specialties.
5. Cooling and Heating Terminal Units.
6. Air Inlets and Outlets.
7. Automatic Control Systems.
8. Testing, Adjusting and Balancing.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Provide air terminal units conforming to the following:

1. Air-Conditioning and Refrigeration Institute (ARI): Comply with applicable ARI standards including the following:

   a. 350 Sound Rating of Non-Ducted Indoor Air-Conditioning Equipment.

   b. 440 Standard for Room Fan-Coil Air-Conditioners.

2. Air Movement and Control Association, Inc. (AMCA): Comply with AMCA 210, "Laboratory Methods of Testing Fans for Rating Purposes."

3. American National Standards Institute (ANSI): Comply with ANSI S1.23, "Designation of Sound Power Emitted by Machinery and Equipment."

4. National Electrical Manufacturers Association (NEMA): Comply with NEMA MG 1, "Motors and Generators."

5. National Fire Protection Association (NFPA): Construct air terminals using acoustical and thermal insulations complying with NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

6. Underwriters Laboratories, Inc. (UL): Comply with UL 181, "Factory-Made Air

Ducts and Connectors."

B. Certification: Submit certification of air terminal unit's compliance with performance shown on the drawings.

C. Commissioning Tests: Air terminal units shall meet commissioning requirements of paragraphs in Part 3 of this Section.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's catalog cuts for air terminal units showing dimensions, capacities, ratings, performance characteristics, gauges and finishes of materials, and installation instructions.

B. Certifications: Submit certified performance data and sound power data for air terminal units to be installed.

C. Shop Drawings: Submit shop drawings showing unit dimensions, construction details, and field connection details.

D. Samples: Submit three samples of each type of cabinet finish.

E. Maintenance Data: Submit maintenance instructions, including lubrication instructions, filter replacement, motor and drive replacement, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals in accordance with requirements of Division 1.

F. Commissioning Test Plan: Submit test plan for air terminal unit tests specified in Part 3 of this Section. Plan shall include test schedules and names and titles of the test personnel who will be conducting the commissioning tests. The test personnel must be employees of an equipment test agency regularly engaged in testing of similar equipment.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Handling: Handle air terminal units and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged air terminal units or components; replace with new.

B. Storage: Store air terminal units and components in clean dry place. Protect from weather, dirt, water, construction debris, and physical damage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (Not Used)

2.2 VARIABLE AIR VOLUME UNITS

A. General: Provide variable air terminal units consisting generally of a sound attenuation box, variable volume damper and motor drive, adjustable maximum air volume regulator and other items as required for proper operation.

B. Lining Material: Provide lining materials in conformance with NFPA 90A and UL 181.

1. Inside surfaces shall have lining material suitable to provide required acoustic performance, thermal insulation, and prevent sweating.

2. Lining thickness shall be not less than 1/2-inch (13 mm).

3. Lining shall be secured to supporting surfaces in such a manner that it will not delaminate, sag, or settle.

4. Surfaces, including edges, shall be faced with perforated metal or coated so that material is not detached by the air stream.

C. Casing: Provide casing constructed of zinc-coated steel not lighter than No. 24 M.S. gauge, (0.70 mm), or aluminum not lighter than 0.04-inch (1 mm) thick, and hemmed, cross broken and reinforced to form a rigid unit.

1. Casing shall have removable panels large enough to provide access to all moving parts, for inspection, adjustment, and maintenance without disconnecting ducts.

2. Panels shall be flush, gasketed airtight, and held in place by screwdriver operated latches or sheet metal screws.

3. Total leakage from casings shall not exceed 1 percent of the specified capacity when subjected to a pressure of 1/2-inch W.G. (125 Pa) in low pressure section and a pressure of 5 inches W.G. (1250 Pa) in high pressure section with all outlets and inlets sealed off.

D. Dampers: Provide dampers and other internal devices constructed of materials that cannot corrode and do not require lubrication or other periodic servicing. Leakage rate of closed dampers shall not exceed 5 percent of specified capacity when close-off pressure differential is 4 inches W.G. (1000 Pa).

E. Controls: Box controller, actuator and room thermostat shall be supplied by the controls contractor and shall be Landis & Steafa suitable for the “Apogee” system. Controls components and actuator shall be obtained from the controls contractor for mounting on the box. The box shall be provided with any additional devices necessary to accept the Landis & Steafa controller and activating devices.

F. Air Volume Controllers: Provide units with integral air volume controlling dampers to provide a variable volume of air to an integral diffusers or remote air supply diffusers through ductwork as indicated on the drawings.

1. Static pressure compensated (i.e. pressure independent) maximum volume regulators shall be field adjustable and calibrated in CFM (L/s) (or have calibration charts) and shall be field adjusted or factory adjusted to the quantities indicated on the drawings.

2. Air volume shall be varied in response to the demands of the thermostat in

conditioned space or mounted in the unit if room air is induced over the thermostat.

3. Provide duct pressure powered controls which operate on between 0.75 and 5.0 inches water gauge. (180 Pa and 1250 Pa). Provide controls which are adjustable from 65 degrees F. and 85 degrees F. (18 degrees C and 30 degrees C) and accurate to plus or minus 1.0 (.5C) degrees C.

4. Provide direct digital electronic control (DDC), including all necessary power supplies and accessories, which operate on 24 VAC or 24 V DC. Provide a reprogrammable digital computer system which can access multiple sensors and provide analog control outputs. The system shall provide proportional and proportional plus integral control algorithms. Provide volume regulator settings from 5 percent of maximum volume to maximum terminal unit volume. Construct units to regulate air volume within plus or minus 1-1/2 percent of setting.

5. Controls shall comply with Section 15950, "Automatic Control Systems."

G. Reheat Coils: Provide variable volume units with one row or two row hot water coil, where indicated on the drawings.

1. Coils shall be selected for entering water temperature and capacity as shown on the schedules.

2. On a reduction in cooling requirements in the space, the air supply quantity shall be gradually reduced to a fixed minimum, specified on the drawings. Then, the reheat coil shall be activated in sequence to maintain thermostat setting.

3. Field adjustable minimum air flow settings shall be incorporated into the volume regulator system specified herein above and factory or field set to the minimum air flow shown on the drawings.

H. Sound Ratings: Rate unit sound power in accordance with ANSI S1.23, "Designation of Sound Power Emitted by Machinery and Equipment" or Air Diffusion Council (ADC) 1062-R4, "Certification, Rating and Test Manual." Sound powers over the full throttling range of the unit shall not exceed the maximum sound powers listed on the drawings even on a rise in inlet pressure (up to 1-inch (250 Pa) at 50 percent of air flow) above the design.

PART 3 - EXECUTION

3.1 INSTALLATION OF VARIABLE AIR VOLUME UNITS

A. General: Install variable air volume units as indicated on the drawings and in accordance with manufacturer's installation instructions.

B. Location: Install each unit level and accurately in position indicated in relation to other work and maintain sufficient clearance for normal service and maintenance, but in no case less than that recommended by manufacturer.

C. Supports: Provide units rigidly supported so they remain stationary at all times.

1. Cross-bracing or other means of stiffening shall be provided as necessary.

2. Method of support shall be such that distortion and malfunction of units cannot occur.

3.2 START-UP

A. Upon completion of installation of the entire variable air volume systems, adjust and balance the systems and all associated air moving systems.

3.3 COMMISSIONING TESTS

A. Preparation for Tests: Before the scheduled commissioning tests, the Contractor shall have prepared the variable air volume units, and all associated air moving systems in the area, in accordance with the contract requirements. Adjusting and balancing must have been performed and the entire air shall be ready for operation.

B. Operational Tests: Demonstrate proper operation of air terminal units and their controls. Thermostats controlling these units shall be turned from low to high and back to low to confirm conformity of unit operation.

END OF SECTION 15935

SECTION 15940 - AIR INLETS AND OUTLETS

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Extent of air inlet and outlet work required in this Section is indicated on the drawings and schedules in the requirements of this Section, and Section 15010, "Mechanical Basic Requirements."

B. Related Sections: Refer to other sections of Division 15 for the following:

1. Testing, Adjusting, and Balancing.
2. Sheet Metal Ductwork.

C. Other Divisions: Refer to Division 16 for air handling troffers.

1.2 QUALITY ASSURANCE

A. Air Diffusion Council (ADC): Test and rate air outlets and inlets in certified laboratories under the requirements of ADC 1062-R4 "Certification, Rating and Test Manual." Each item shall bear the ADC certified rating seal.

1.3 SUBMITTALS

A. Division 1: Conform to the requirements of Division 1, Section 01003, "Submittals."

B. Product Data: Submit manufacturer's standard technical product data including capacity ratings, throw, drop, diffusion, terminal velocities, adjustability, construction details, finish and mounting details.

C. Inlet and Outlet Schedule: Submit a schedule of proposed air inlets and outlets, keyed to the Contract Drawings and indicating the proposed type, size, air quantity, pressure drop and location of each device proposed under this Contract.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Original Containers: Deliver air inlets and outlets to the site in manufacturer's original containers.

B. Protect From Damage: Do not install bent, marred or damaged devices. Replace with new.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (Not Used)

2.2 AIR INLETS AND OUTLETS: GENERAL

A. Construction: Provide devices constructed of steel or aluminum.

1. Treat steel with zinc phosphate or zinc chromate after fabrication.

2. Grind, polish and factory prime.

3. Factory finish with white finish.

4. Roll or reinforce exterior faces and edges.
5. Mitered joints and butt connections shall mate within 0.010-inch (0.25 mm) maximum crack.

6. Surface finish shall be smooth within 0.005-inch (0.13 mm) at welds, joints, clamping points and splices.

7. Offsets and bends shall be mitered.

8. Terminals shall mate with the associated duct, plenum or boot to form an airtight joint.

2.3 REGISTERS

A. Type: Supply registers shall be adjustable double-deflection type, formed steel or extruded aluminum.

B. Bars: Provide vertical adjustable face bars and horizontal adjustable rear bars spaced 3/4-inch (19 mm) on centers.

C. Fins: In lieu of rear bars, fixed horizontal fins, removable as a unit from the register face, and providing three position up-down adjustment, may be furnished.

D. Frames: Provide stamped or rolled steel or extruded aluminum frames fitted with felt, neoprene or plastic gaskets.

E. Dampers: Provide register dampers of formed steel, cadmium plated, gang key operated, opposed blade type, and arranged so that the operating mechanism shall not project through any part of the register face.

F. Mounting Hardware: Provide round or countersunk head Phillips screws.

G. Air Extractors: Provide 18 gauge frames, 22 gauge (1.3 mm frames, 0.85 mm) curved steel blades, fixed pattern, screwed to the duct collar, and sized to match register dimensions.

H. Return registers shall be as specified for the supply registers with blades fixed at the 45 degrees deflection angle and parallel to the long dimension.

2.4 GRILLES

A. Construction: Construct as specified for supply registers, except omit register damper.

B. Bars: Provide fixed horizontal face bars with 3/4-inch (19 mm) spacing and 15 degree (0.25 rad) downward blade angle.

C. Return grilles shall be as specified for the supply grilles with blades fixed at the 45 degrees deflection angle and parallel to the long dimension.

2.5 DIFFUSERS

A. Ceiling Diffusers: Provide square or types as indicated on the drawings.

B. Edge Details: Diffuser edges and framing shall be compatible with the type of ceilings in which the diffuser is installed. For plaster ceiling provide plaster rings.

C. Materials: Construct diffusers of steel or aluminum with exposed edges rolled and rounded.

D. Access: Internal parts of circular, square or rectangular diffusers shall be removable, including volume regulators, diffuser face, dampers and equalizing devices.

1. Removal of parts, including internal assembly, shall be accomplished without the use of special tools.

2. Removal of diffuser face shall not disturb the distribution pattern.

E. Finish: Provide baked enamel finish on visible face. Interior and concealed parts shall be flat black or dark gray.

F. Regulator: Provide, for each diffuser, a factory fabricated volume regulator of the opposed blade gang-operated type with removal key.

G. Pressure Range: Design to allow equal distribution pattern, both horizontal and vertical, for diffusers with pressure drops from 0.10 to 0.40 inches water gauge. (25 to 100 Pa).

H. Manufacturer: Regulators, dampers, diffusers, and extractors shall be the product of the same manufacturer.

I. Extractors: Provide adjustable extractors, furnished by the diffuser manufacturer, in each ceiling diffuser.

0.1 LINEAR DIFFUSERS

A. Adjustable Pattern: Provide adjustable pattern linear diffusers with pattern adjustment from horizontal to 45 degrees down.

B. Volume Regulators: Provide hinged air volume regulators with separate blade assemblies for controlling volume.

C. Rigid Construction: All parts such as blades and dampers shall be structurally rigid so as to operate uniformly over the entire length.

1. Linear diffusers with components which twist, bend, warp or buckle shall be removed and replaced with new structurally sound units.
2. Align butt edges using slotted key strips or other concealed means.

D. Plaster Frames: In plastered ceilings use pre-aligned plaster frames set flush with finished ceiling.

E. Concealed Hardware: Screws, bolts and mounting hardware shall be concealed.

F. Joints: Stagger butt joints of diffuser face and plastered frames minimum of 24” (600 mm) apart.

G. Drawings: Provide dimensioned shop drawings of linear diffuser mounting, plenum dimensions, plenum connections, damper connections and branch ductwork.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordination: Coordinate the location of grilles, registers and diffusers with other trades.

1. Examine architectural floor plans, reflected ceiling plans and elevations and arrange for duct taps to be so placed that the installation of air outlets will present a uniform relationship with architectural features, lighting, sprinkler heads, speakers and smoke detectors.

2. On plain walls, if not otherwise indicated, locate sidewall registers approximately 8 inches (200 mm) down from the finished ceilings.

3. Adjust the face and rear bars of supply registers to provide a diffusion pattern such that the terminal velocity point is approximately 70 percent of the "room" width and 5 to 6 feet (1500 mm to 1800 mm) above the finished floor, at a velocity of 0.1 m/s to 20 to 50 fpm. (0.25 m/s).

4. On projects with reflected ceiling plans, locate outlets to conform to that plan.

5. If no reflected ceiling plans are included in the Contract Documents, coordinate the location of air outlets with other trades before cutting in ceiling and sidewall taps.

B. Painting: Where the interior surfaces of ductwork are visible through the blades of supply or return grilles, paint interior visible surfaces with one coat flat black paint.

END OF SECTION 15940

SECTION 15950 - AUTOMATIC CONTROL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: The extent of automatic control work is indicated on the drawings and schedules and by the requirements of this Section, and Section 15010, "Mechanical Basic Requirements". The variables to be controlled may include, but are not limited to temperature, pressure, humidity, enthalpy, velocity and simple on-off operations. The work includes:

1. The provision of a complete and operational control system, including all devices necessary to perform the functions herein described or indicated on the drawings.

2. The provision of 120 and 208 line voltage and 5 and 24 volt low voltage wiring, conduit, installed in accordance with National Fire Protection Association (NFPA) 70, "National Electric Code" and Division 16 of these specifications.

3. All drilling, cutting and patching associated with the installation of control systems.

B. Types: Provide automatic control systems of the following types:

1. Digital Electronic

C. Other Sections: Refer to other Division 15 sections for:

1. Testing and balancing of air and water distribution system.

2. Controls furnished as an integral part of factory manufactured equipment.

3. Meters and gauges.

D. Other Divisions: Refer to other divisions of the specification for:

1. Extent of power wiring to motor controllers and relays.

1.2 QUALITY ASSURANCE

A. General: Quality assurance for automatic control systems includes a multi-step program consisting of a pre-qualification procedure for the installation specialist; a system engineering, products and shop drawing phase; installation; testing and adjusting; reporting; commissioning testing and verifications; operating instruction and training; and the submission of maintenance and operating manuals.

B. Manufacturer: The existing systems controlling the Fremont Building as well as the Erskine Hall Building is by Landis & Staefa the apogee type. The new system will be by the same manufacturer and shall be fully equipped with the exiting controls and systems which includes the following:

1. Address of the Manufacturing Plant,

2. Name, address and telephone number of the local representative, a general sales and engineering bulletin covering the full line of products manufactured; a certification that the products proposed for this contract have been in continuous and successful use for not less than 2 years; general catalog information covering the characteristics of the systems proposed for this Contract; a statement that the components and systems proposed will be maintained and supported by the manufacturer for parts and service for not less than 10 years; and that the system as a whole and 75 percent of the components shall bear the nameplate of the manufacturer.

C. Specialist: Installation of automatic control systems shall be performed under the direct supervision of a specialist, authorized by the manufacturer. The field cabinets of the installation shall bear the nameplate of the specialist subcontractor, so the work can be seen to be a reflection of his professionalism. Within 14 days after notice to proceed submit for the control installation specialist the following:

1. Field superintendent's name

2. Telephone number and address

3. A list of three projects of equal size and complexity to this Contract, which were directly supervised by the proposed superintendent-specialist.

4. For Each Project List: The name of the project, location, project description, construction cost, name and telephone number of the owner's representative, date installation started and date installation was completed.

D. Specialist Subcontractor: In lieu of the above requirements, the temperature control system may be installed by a "Specialist" subcontractor as defined in the "SPECIAL CONDITIONS" section of this specification. Specialist shall have not less than two years experience in installing systems of comparable complexity to those required on this project and shall submit proof of his successful completion of such work on request. Specialist shall install equipment of a single manufacturer except where the manufacturer does not fabricate the particular device required. Specialist shall further have in his employ a regular service group trained in the servicing and maintenance of all equipment and devices installed under this contract, and shall maintain a full line of replacement components. The field cabinets of the installation shall bear the nameplate of the specialist subcontractor.

E. Pre-Qualification Action: A prompt review and action upon the pre-qualification of the control system's specialist will be carried out. Should approval be given to the control system's specialist, then the subsequent steps of the quality assurance procedures may begin. If, the experience or the qualification of the proposed specialist are not in accordance with the requirements of the contract documents then the specialist will be rejected and alternatives resubmitted for approval.

F. Systems Engineering: The systems engineering phase shall include the selection and integration of components into a complete system which will meet the performance and prescriptive requirements of the Contract, together with drawings, specifications, descriptions of operation, diagrams and other materials listed under "Submittals" paragraph of this Section.

G. Testing and Adjusting During and After Installation:

1. The testing and adjusting includes the submission of a test plan which shall describe in detail the method by which each component, subsystem, and system will be tested, calibrated, adjusted, and retest after installation in accordance with the specified sequences of operation and other characteristics of the control system. A report on test results, including set points and operating ranges of all components shall be submitted. The set points and operating ranges of all components shall be recorded to be submitted as part of the commissioning test results.

2. The testing specified in this paragraph shall not replace the testing specified in "Commissioning Tests and Verification" article of this Section.

H. Commissioning Testing and Verifications: The final phase of the quality assurance program of the project is the commissioning testing and verifications. This phase is to assure that the project is fully completed and that the systems are performing in accordance to specifications from end to end of the control systems. Demonstrations of the automatic control systems to the commissioning team in accordance to the requirements specified in Part 3 of this Section are required. A report on test results, including set points and operating ranges of all components, shall be submitted.

I. Testing: The testing phase of quality assurance includes the submission of a test plan which shall describe in detail the method by which each component, subsystem, and system will be tested, calibrated and retest after installation to perform in accordance with the specified sequences of operation and other characteristics of the control system.

J. Reporting and Demonstration: This phase shall include the submission of a written report describing the "actions taken during the testing" phase, and including the set points and operating ranges of all equipment and a demonstration that the system performs in accordance with contract requirements.

K. Operating Instructions and Training: This phase of quality assurance includes the training of operating personnel utilizing written operating instructions prepared and approved under the "Submittals" paragraph of this Section, and the mounting of laminated control diagrams where directed.

L. Maintenance Manuals: This phase includes the submission of four hard bound copies of all manufacturers' cuts, maintenance and operating instructions, test reports and demonstration material, copies of control diagrams, and copies of the manufacturers' certifications.

1.3 SUBMITTALS

A. Pre-Qualifications: Within 14 days after notice to proceed, submit four copies of the pre-qualification data specified under "Quality Assurance" article for the superintendent of the installation specialist proposed. Upon receipt and approval superintendent's pre-qualifications, proceed with the preparation of shop drawings and other submittal data.

B. Division 1: Conform to the requirements of Division 1, Section 01003 “Submittals."

C. Shop Drawings: For each system to be controlled, prepare a drawing which includes a system flow diagram, control diagram, sequence of operation and schedule of components. Control diagrams shall be complete with end-to-end connections of piping and wiring from component terminal.

D. Manufacturer's Data: For each manufactured device or subsystem submit manufacturers' specifications and printed photograph of the proposed device or subsystem. Include engineering descriptions, principle of operation and application, and proposed model, style or size clearly indicated.

E. Shop Drawing Procedure shall be as follows:

1. The Diagrams and Sequence shall thoroughly show and tell the operation of the systems.

2. NIMA will make comments, requirements, and additions for improvements.

3. The Contractor shall then comply with NIMA's comments in a cooperative manner.

4. Approval to build controls will not be given until the submittal is to NIMA's reasonable satisfaction.

5. At some points, NIMA will add NIMA operating instructions for NIMA operating personnel, for inclusion in the Control Sequence, so that material will be in the maintenance manuals and in the framed diagrams. This shall be added at the appropriate times. One such point might be during initial shop drawing review and approval. Another might be after the final control operation is resolved.

6. See other requirements under "Systems Diagrams" in Part 2 of this section of this specifications. "

PART 2 - PRODUCTS

2.1 MANUFACTURERS (Not Used)

2.2 SYSTEMS INTEGRATION

A. Control Loop Characteristics: Carefully evaluate the characteristics of each control loop, the time constants, equipment characteristics, control accuracy, and reliability and provide a system which will operate smoothly, without hunting, and within the accuracy’s specified.

B. System Components: Select components including sensors, transmitters, controllers, control devices, actuators, and instrumentation considering such factors as hysteresis, relaxation time, span, limits, and response time.

2.3 CONTROLLERS

A. General: Provide digital electronic controllers for each local control loop.

1. Provide controllers with local adjustable set point, adjustable proportional band for analog controllers or adjustable differential for two position controllers.

2. Provide adjustable secondary input authority for dual input controllers with remote set point adjustment.

3. Provide integral or test connections for measuring input and output signal.

4. For controllers with test connections deliver two complete calibrated test kits, three-gauge type, with carrying cases.

B. Electronic Digital System Characteristics: Provide a system of digital control, which shall have all of the following system characteristics. Systems, which do not conform to all of the following requirements, will not be acceptable.

1. The system shall consist of multiple, microprocessor based, field programmable digital controllers providing direct digital control. The digital controller, power supplies, input/output and other components specified, including metal cabinet will be referred to as a "Field Panel."

2. The field panel shall be capable of performing its assigned local loop control and other functions as a stand-alone unit. The field panel shall be capable of having data loaded both through portable programming devices and a portable terminal; and down loaded from a central computer. It shall perform all specified local loop control functions without interaction to other field panels or to a host computer. Systems that rely only upon the down loading of information and data from a host computer or processing local control loop functions in a central computer will not be acceptable.

3. The field panel shall be able to communicate to a future remote central computer, and allow monitoring, display, control and modification of every sensing point and control point data indicated on the drawings.

4. The field panel shall utilize control algorithms that permit proportional, integral, and derivative control. Control algorithms shall permit one, two or three-mode control as specified or indicated on the drawings.

5. Each field panel shall be capable of handling multiple control loops, with one or more digital controllers.

6. The system shall utilize industry standard sensors.

7. The field panel shall provide both analog and binary output control. Analog outputs shall be compatible with industry standard transducers. Provide a modulating analog output control signal. Binary output control commands shall be implemented through interposing control relays. The interposing relays shall not be mounted in the field panel enclosure.

8. Field panels shall be of modular construction. Each field panel shall be identical in construction. The system shall utilize interchangeable components. The

modular construction of the system shall permit quick repair, ease of expansion, plug in auxiliary function cards, and the use of standard control cards.

9. The power supplies in all field panels shall be identical and interchangeable.

10. Each field panel with sensors and controlled devices shall be capable of automatic, unattended restart in the event of electrical power failure. In the event of electrical power failure all controlled devices shall move to their predetermined "normal" positions. By normal, it is meant that spring-close valves shall close, spring-open devices shall open, spring return devices will return and magnetically held devices will move to the position dictated by the force of gravity. Upon the restoration of electrical power, the field panel shall automatically restart and provide control to its connected systems after power failures of up to 72 hours.

11. The field panel software and microcomputer operating system shall reside in nonvolatile memory.

12. Site specific application data, setpoints and operator-entered data shall be stored in volatile memory.

13. Nonvolatile memory shall include PROM, EPROM, EAROM and ROM.

14. RAM, battery backed or not, is considered volatile memory.

15. The preceding terms describe a class of solid state semi-conductor memories manufactured with LSI (large-scale-integration) techniques. These terms are expanded as follows:

    a. PROM - Programmable Read Only Memory
    b. EPROM - Erasable PROM
    c. EAROM - Electrically Alterable ROM
    d. ROM - Read Only Memory
    e. RAM - Random Access Memory

C. Field Panels: Provide field panels as follows.

1. Each field panel shall consist of a microcomputer-based controller, power supplies, input/output modules, termination modules and battery.

2. Provide field panels where indicated. Provide additional digital controllers, if required, to support the control loops specified, the sequence of operations, number of monitoring points or other criteria to permit the field panel capacity to meet the specified functional requirements of the project.

3. Each field panel shall be capable of operation as a completely independent unit and as a part of a facility-wide central control system.

4. Each field panel shall include its own operator's keypad. The operator's keypad shall be either a dedicated device as part of the field panel or plug-connected as a portable device.

5. The battery shall be able to support all memory within the field panel if the commercial power to the field panel is interrupted. In addition, an analog monitoring point in each field panel shall be dedicated to monitor the voltage level to the nearest 100th of a volt as a method of monitoring battery condition. The battery condition point shall have high and low alarm limits and shall be considered a critical alarm when the field panel is connected to the central computer. Provide a charging system in each field panel for the battery.

6. Underwriters Laboratories, Inc. (UL) shall list the field panel or components against fire and shock hazard as a signal system appliance unit. The field panel shall meet all requirements of FCC Regulations, Part 15, for radio frequency emissions. Submit certification stating that equipment supplied complies with Part 15.

7. Each field panel shall receive signals from industry standard sensors and input devices. Each panel shall have the capability to monitor the following types of inputs:

   a. Analog inputs: 4 to 20 mA and 0 to 10 V DC.

   b. Binary inputs: Dry contact closure and pulse accumulator.

   c. Provide transducers and/or signal conditioning to adapt other sensor types.

   d. Field panels that permit the direct connection of resistance type sensors will be acceptable if the system accuracy, data resolution, value accuracy and sensor interchangeability, comply with all other requirements of the specification.

8. The field panel shall directly control actuators and control devices. Each field panel shall be able to provide the following control outputs:

   a. Binary outputs: Contact closure

   b. Analog outputs: 4 to 20 mA and 0 to 16 V DC.

   c. Systems that do not provide direct analog outputs will be acceptable providing that they generate the specified output signal through transducers utilizing pulse width modulation procedures and that these systems provide signal feedback to the control logic where system stability requirements dictate.

9. Each field panel shall perform control functions and other routines, specified under "Field Panel: Software and Firmware" paragraph. All control functions shall be executed within the field panel without interaction required by a central host computer. loop control shall be executed via direct digital control algorithms. Direct Digital Control shall be defined as a control technique in which the process variable is continuously monitored by a digital computer,

which accomplishes loop control by calculating a control solution for output to a control device.

10. Each field panel shall monitor analog input, perform A-to-D conversion, and hold the digital value in a buffer for interrogation. Provide signal conditioning for each analog input. Individually calibrate all analog inputs for zero and span, in hardware or in software.

11. Each field panel shall perform D-to-A conversion. Individually calibrate all analog outputs for zero and span. Provide short circuit protection.

12. Each field panel shall accept binary inputs, on off, open-close, or other two state data. Provide isolation and protection against input voltage up to 180 VAC peak.

13. Each field panel shall provide Binary Output by contact closures for momentary and maintained operation of field devices. Provide electromagnetic interference suppression on all output lines to limit transients to non-damaging levels. Provide isolation and protection against voltage up to 180 VAC peak. Provide contacts rated for 2 A at 24 VAC.

14. Each field panel shall provide pulse accumulator function with the same characteristics as the Binary Input, except that, in addition, a buffer shall be provided to totalize pulses between interrogations. The pulse accumulator shall accept rates up to 10 pulses per second.

15. Each field panel shall be enclosed in a metal cabinet. The cabinet shall be constructed of 16 US gauge (1.5 mm) sheet steel, Provide sufficient access for wire and conduit to enter the cabinet. The cabinet shall have a continuous piano hinge door and a pin tumbler lock. All field panel locks for the project shall be keyed alike. The cabinet shall be shipped to the project for installation without electronics. The electronics shall be added at the time of wire termination and system commissioning. All control wiring and system communications shall be electrically terminated inside the field panel.

16. Provide a 15 A duplex receptacle inside or immediately adjacent to the field panel. The receptacle shall be energized when power is disconnected from the field panel.

17. Ground the field panel and power supply with a minimum No. 12 (2.8 mm) THHN unbroken ground wire to the building earth ground system. There shall be a maximum of 5 ohms measured between the ground at the field panel and the building ground system.

18. Provide radio frequency interference (RFI) filters on the power to the field panel to prevent power line disturbances from affecting the operation of the field panel microcomputer.

19. Provide a master electrical power disconnect switch inside the field panel to disconnect all external power to the cabinet for maintenance and repair. The disconnect switch shall not affect the duplex receptacle hereinbefore specified.

20. Provide screw type terminal strips in the field panel for the termination of all field wiring. Lay out terminal strips in a neat and orderly fashion and label each termination. All wiring entering the panel shall be routed through the panel wireways in a neat and workmanlike manner, properly tied or laced and terminated.

21. Provide the communications equipment, firmware and software necessary to communicate with a host central computer. The field panel shall permit all local operator functions to be performed at the central computer.

22. The field panel shall provide for the receipt of other information from a future central computer. The field panel shall support the central computer in performance of centralized electrical power management and demand limiting.

23. Provide conduit and wire to connect the field panel to the nearest adequate source of emergency electric power.

D. Field Panel: Software and Firmware

1. Provide all algorithms and control sequences specified and indicated.

2. Provide PID 1, 2, and 3 mode control algorithms. Proportional or single mode control will be implemented for terminal units. All other control loops shall be proportional plus integral or PI 2-mode control. Implement proportional, integral, plus derivative or PID or 3-mode control for those control loops subject to stability problems, large load shifts or where one or 2-mode control is not satisfactory.

3. The field panel shall continue to operate and perform local loop control while setpoints and data are modified.

4. Each field panel shall be capable of performing the following routines as a minimum.

   a. Control sequences specified for each local loop
   b. Time of day scheduling
   c. Economizer control
   d. Supply air reset
   e. Chilled water reset
   f. Outdoor air reset
   g. Zero energy band program
   h. Unoccupied cycle

5. Provide self-contained diagnostics in each field panel. These routines shall continuously monitor the operation of the unit and shall report malfunctions to the central computer. Provide diagnostics at the field panel that can be activated at the local operator's keypad for the determination of system problems and panel malfunctions. It shall be possible to annunciate these malfunctions at the host computer, if connected.

6. Provide default values and procedures when sensed values are unreliable or out of range. Default values shall be user changeable through the local keypad.

7. The operating system (OS) shall be stored in firmware (i.e. ROM, PROM, EAROM) and operate independently of any central computer. The operating system shall run the controllers and the I/O modules, accept analog and binary inputs, produce analog and binary outputs, and provide alarm monitoring. The firmware shall allow for scaling and for calibration of sensor lead length variations to insure instrumentation accuracies. The firmware shall provide for automatic restart of equipment based on current real time without operator intervention, using default values.

8. Provide a clock routine within the field panel. The clock routine shall remain active during periods of power failure up to 120 hours. The clock shall maintain the calendar date, 24-hour military time and shall be used for the automatic start up of the system upon resumption of electrical power. The central computer shall reset the field panel clock once a day. In the event of power failure, communications network failure, or failure of the field panel, its clock shall automatically be reset by the central computer upon the resumption of central computer to field panel communications.

9. Software application package shall allow the user to program custom control sequences directly into the field panel memory. Selected input sensor data, parameters, and algorithms shall be entered into the custom software program, and the result of the algorithms shall then be used to position actuators and implement control. The program shall permit interlocks, calculations of heating or cooling energy, flows, outputs, provide hysteresis compensation, scaling, offset, linearization, summation, multiplication, division, default modes, start up and check out tests, and other functions.

10. Provide a portable floppy disk or cassette tape-loading device and necessary interface hardware and software for the system user to save, and verify the field panel software and operating data. It shall be possible to download the field panel software and operating data from the central computer.

E. Field Panel: Operator's Keypad

1. Provide an operator's keypad at each field panel, which shall be either a permanent part of the field panel or shall be a portable plug connected device. If portable, provide one keypad for each 10-field panels. Each field panel shall have a permanently attached plug connector that will mate with the keypad.

2. Each keypad shall include an alphanumeric display.

3. The operator shall be able to obtain the current sensor value for all connected sensors, the current operating status of equipment and be able to issue control commands by use of the keypad.

4. The operator's access to the system shall be through four levels of security. Security protection shall be in the form of codes, passwords, or locally sensed switching. The operator shall be able to perform the following functions:
   a. Display the value of a measured variable

   b. Start or stop equipment

c. Monitor the status of equipment being controlled

d. Display the setpoint of a control loop

e. Add/delete control loops to the system

f. Add/delete points to the system

g. Assign sensors and/or actuators to a control strategy

h. Enable or disable control sequences

i. Generate hard copy records on a portable printer or storage device

j. Add, delete or change setpoint values, point alarm values

F. Wire/Cable Labeling: Label wire and cable as follows.

1. label each cable and each conductor within 6 inches (150 mm) of the termination point. Cable and wire identification shall match the wiring identification shown on the installation and record drawings.

2. Wire identification labels shall be securely affixed to the wire and shall be of the preprinted type providing a durable vinyl or plastic covering over the printed lettering.

3. Wire identification through color coding, embossed label tape, paper tags attached with string and handwritten labeling will not be acceptable.

G. Instrumentation Panel: Provide instrumentation panel as follows.

1. Transducers, signal conditioning devices and interface or interposing relays shall not be mounted in the field panel cabinet, and shall be mounted in a NEMA 1 enclosure adjacent to the field panel.

2. The instrumentation enclosure shall be constructed similar to the field panel cabinet including the requirements for a hinged door and a pin tumbler lock with keying common to the field panels.

3. All wiring to the instrumentation panel shall be properly terminated on screw type labeled terminal strips or at device terminal strips. All wiring within the instrumentation panel shall be neatly routed, tied or laced and installed in a neat and workmanlike fashion.

4. The requirements for labeling of wiring within the field panel shall also apply to the instrumentation panel. All pneumatic tubing entering the instrumentation panel shall enter through bulkhead fittings. The instrumentation panel shall be painted to match the field panel.

H. Intrusion Alarm: Provide an intrusion alarm as follows.

1. Provide an intrusion detection microswitch in each field panel and in each instrumentation panel.

2. Mount the microswitch adjacent to the keylock door strike and connect to a binary input point. Where instrumentation panels are mounted within 10 feet (3 m) of a field panel, the instrumentation and field panel intrusion switches shall be connected to a single binary input point.

3. When any cabinet door opens, an alarm shall be annunciated at the central computer identifying which panel door is open.

I. Transient Protection: Provide transient protection as follows.

1. Provide power line surge protection. Protect all equipment from power line surges. Equipment shall meet the spike susceptibility requirements of MIL-STD-461, "Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference," Part 7, CS06. Provide protection near equipment in a separate metallic enclosure at ground potential and as necessary at the power panel to ensure protection against surges. Fuses shall not be used for surge protection.

2. Provide sensor and control wiring surge protection. Protect all equipment against surges induced on control or sensor wiring installed outdoors. Conform to Institute of Electrical and Electronics Engineers (IEEE) C37.90.1, "Search Withstand Capability Tests for Protective Relays and Relay Systems," surge withstand capability test. Fuses shall not be used for surge protection.

3. Provide communications link surge protection. Protect all communications equipment against surges induced on any communications link. All cables and conductors which serve as communications links between the central computer and each field panel shall have surge protection installed at each end that conform to IEEE C37.90.1 surge withstand capability test. Provide protection near equipment in a separate metallic enclosure at ground potential. Fuses shall not be used for surge protection.

4. Provide communications links overvoltage protection. Protect all communications equipment, such as Modems and line drivers, against overvoltage on any communications link conductors. All cables and conductors which serve as communication links shall have overvoltage protection for voltage up to 480 VAC RMS, 60 Hz installed.

5. Provide sensor and control wiring overvoltage protection. Protect sensor and control wiring against overvoltages, noise spikes and induced voltages.

J. System Accuracy: Provide system accuracy in accordance with the following.

1. Each local system shall maintain end-to-end accuracy for one year from sensor to controlled device for the applications specified.

2. Space temperature with a range of 50 to 85 degrees F. plus or minus 0.75 degrees F. (10EC to 30EC "0.4CE) for conditioned space; 30 to 130 degrees F. plus or minus 1.0 degree F. (0EC to 55EC "0.5CE) for unconditioned space.

3. Duct temperature with a range of 40 to 140 degrees F. plus or minus 1.0 degree F. (4EC to 60EC "0.5CE).

4. Outside air (OA) temperature with a range of minus 30 to plus 130 degrees F. plus or minus 2.0 degrees F.; (-35EC to 55EC "1CE) with a subrange of plus 30 to plus 100 degrees F. plus or minus 1.0 degree F. (0EC to 40EC "0.5CE).

5. Water temperature with a range of 33 to 100 degrees F. plus or minus 0.75 degrees F.; the range of 100 to 250 degrees F. plus or minus 2.0 degrees F.; (0EC to 40EC "0.4CE; the range of 35EC to 120E C "1CE); and water temperatures for the purpose of performing heating/cooling calculations using differential temperatures to plus or minus 0.5 degrees F. using matched sensors. ("0.25CE using matched sensors.)

6. High temperature water with a range of 0 to 500 degrees F. plus or minus 3.0 degrees F. (-18EC to 260E C "1.5CE).

7. Pressure with a range for the specific application "2.0 percent of range.

8. Flow with a range for the specific application "3.0 percent of range, and flows for the purpose of heating/cooling calculations to "2.0 percent of range.

9. kWH and kW demand with a range for the specific application "1.0 percent of reading.

10. An analog value input to the system's equipment via an analog input shall be displayed with a maximum error of 0.5 percent. This error shall not include the sensor or signal conditioning external to the analog input.

K. Analog Input Resolution: The minimum analog value resolution shall be one quarter of the accuracy tolerance value specified. Resolution shall be defined as the least measured value difference between two adjacent values, in engineering units, that can be distinguished one from the other. Provide signal conditioning to improve analog input resolution, if required.

L. Accuracy and Stability: Equipment shall be selected for the appropriate range of the application. Equipment selected with ranges in excess of the application will be replaced at the Contractor's expense.

2.4 SENSORS

A. General: Provide analog sensors for temperature controllers. Provide sensors with an output signal that varies continuously with the sensed temperature, within a specified range, of the thermistor, resistance or pneumatic type.

B. Manufacturer: Temperature sensors shall be made by one manufacturer.

C. Space Sensors: Provide space or room sensors with base plates through bolted into masonry or wall studs, brushed cast aluminum or 1.6 mm ground and polished Type 316 stainless steel [covers with Allen head screws] [aspirated type with flush plate and locking screws].

D. Insertion Type: Stem or extended surface sensitive type with screw mounting plate and galvanized sheet steel insulation mounting box.

E. Immersion Type: Stem or tip sensitive type with threaded immersion well base.

F. Sensing Elements: Hermetically seal, except for bimetal type for room thermostats and rod and tube type for pneumatic sensors. Stem, tip or extended element Type 304 stainless steel or annealed copper.

G. Casing: Casing shall be constructed of watertight, vibration-proof, heat resistant high strength phenolic or 316 stainless steel.

H. Sensor Wells: Provide 304 stainless steel, bronze or monel machined wells, compatible with the immersion medium, and heat sensitive transfer material or liquid between sensor and well surface.

2.5 ELECTRONIC ANALOG SENSORS

A. Range: Sensors shall operate within the range of -34EC to 105EC for heating, ventilating and air conditioning (HVAC) systems.

B. High Temperature Sensors: For high temperature water applications provide sensors with a range of -18EC to 260EC.

C. Accuracy: Provide electronic analog sensors with an accuracy of plus or minus 0.15EC.

D. Time Constant Response: Provide sensors with a time constant response to achieve 60 percent of a step temperature change in 6 seconds in air or water flowing at 1 m/s.

E. Interchangeability: Sensors of the same type shall be interchangeable without calibration.

2.6 PRESSURE SENSORS

A. Overpressure Protection: Provide pressure sensors impervious to instantaneous pressure changes of 150 percent of working pressure but not less than " 345 kPa.

B. Adjustment: Provide sensors with external adjustable span, adjustable zero and pulsation suppression.

C. Finished Spaces: Conceal pressure sensors in recessed stainless steel housing with removable perforated brushed stainless steel cover.

D. Sensor Characteristics: Provide pressure sensors with the following characteristics:

1. Ambient Temperature: 4EC to 60EC.
2. Isolation Valves: Provide pressure sensors with stainless steel needle isolation valves between each sensor and sensor pressure source. Provide differential pressure sensors with 3-valve manifold for isolation and nulling.

3. Siphon: On steam systems provide pressure sensors with a pigtail siphon between the sensor isolation valve and sensor. Provide condensate wells and blowdown valves for differential pressure sensors.

4. Provide switching type sensors with platinum alloy, silver alloy or gold plated wiping contacts rated for the application, voltage and power levels.

5. Provide valved calibration taps adjacent to each pressure sensor for calibration.

2.7 STATIC PRESSURE ANALOG SENSORS

A. Types: Provide diaphragm sensors with solid state pre-amplifier electronic systems or slack-diaphragm type sensors on pneumatic systems.

B. Characteristics: Provide analog sensors with the following characteristics:

1. Sensor span shall be not less than 150 percent and not more than 300 percent of the working pressure.

2. Accuracy shall be 0.5 percent of calibrated span including combined effects of linearity, hysteresis and repeatability.

2.8 DIFFERENTIAL PRESSURE ANALOG SENSORS

A. Types: Provide differential pressure analog sensors of the bellows or filled diaphragm types for pneumatic systems solid state pre-amplifier types for electronic systems.

B. Characteristics: Provide sensors with the following characteristics:

1. Sensor span not less than 150 percent nor more than 300 percent of the working differential pressure.

2. Accuracy of 0.5 percent of calibrated span, including combined affects of linearity, hysteresis and repeatability.

3. Pressure sensor shall withstand overpressure of not less than 200 percent working pressure and full vacuum underpressure without damage, changes in sensor accuracy or deformation.

2.9 DEW POINT AND RELATIVE HUMIDITY SENSORS

A. Dew Point Sensors: Provide analog salt-phase transition or dual cooled mirror type sensors with an accuracy of plus or minus 1.7 degrees C. dew point over the range of -12EC to 40EC dew point.

B. Relative Humidity Sensors: Provide analog precision resistance or hydro-mechanical gauge type relative humidity sensors, with an accuracy of plus or minus [2] [5] percent of relative humidity over a range of 10 to 90 percent relative humidity.

C. Shields: Provide 316 stainless steel weatherhoods and shields to protect outdoor sensors from sunlight, snow, ice, wind and rain and provide fan powered aspirator complete with wiring if recommended by the manufacturer.

D. Indoor Covers: Sensors located in public spaces shall have brushed 1.5 mm 316 stainless steel covers or recessed aspirating boxes with Allen head screw mounting plate.

2.10 FLOW SENSORS

A. General: Provide sensors for measuring flow in piping and ductwork that are compatible with static pressure and differential pressure analog of the pneumatic and electronic controllers served.

B. Turndown: Provide sensors with an output characteristic, which gives a continuous mathematical function over the full range of flow from maximum to minimum required.

C. Location: Mount flow sensor concealed in public spaces or exposed in mechanical equipment room.

2.11 THERMOSTATS

A. Types: Provide electronic thermostats which operate in an analog proportional or binary two position mode as required by the sequence of operation.

B. Mounting: Mount thermostats in non-public spaces except room thermostats.

C. Electric Analog Thermostats: Provide electric analog thermostat with the following characteristics:

1. Sensor shall be of the bulb or capillary type, which shall actuate a 135-ohm 3-wire potentiometer for 24, VAC proportioning control action of balanced bridge motor actuators, equipped with feedback potentiometers.

2. Sensor shall have adjustable setpoint range of not less than 44EC throughout the range of minus 18EC to 120EC.

3. Adjustable proportional band ranges from 1.7EC to 14EC and capillary length of not less than 1.5 m shall be provided.

D. Electric Two-Position Duct and Immersion Thermostats: Provide thermostats with bimetal or bulb and capillary type sensor actuating one or more switching contacts.

1. Contact shall be rated for the imposed load or shall be a pilot duty type and provided with a control relay.

2. Thermostats shall have adjustable setpoint throughout the range of -18EC to 120EC.

3. Differential shall be adjustable from 1.7EC to 6EC for each contact for refrigeration, boiler and industrial applications.

4. Fixed differential thermostats with differentials of 0.75 may be provided for On-Off control of unit heaters, ventilating fans and similar applications.

5. Provide capillary tubes in the 1.5 m to 6 m lengths to suit applications.

E. Freeze Protection Thermostats: Pneumatic or electric freeze protection thermostats shall be provided with capillary elements, and special purpose insertion elements not less than 6.1 meter in length for the face of coils up to 7.4 m^2. Freeze protection thermostats shall have the following characteristics:

1. A freezing condition at any 300 mm length increment anywhere along the sensing element shall activate the thermostatic switch.

2. Switch shall require manual reset.

F. Weather Shields: Provide weather shields and outside air sensing elements with the following characteristics:

1. Mount elements and shields on the north face of the building or location out of direct sunlight.

2. Construct shields of 1.5 mm 316 stainless steel with flanges bolted to a backplate with not less than four 1/4-inch (6 mm) diameter stainless steel bolts. Mount backplate to the building structure with expansion bolts.

3. Construct shields to inhibit solar effects. Construct shields in a rectangular box configuration with ventilating raintight louvers to preclude the entrance of snow, ice and rain. Design for crossflow and vertical air circulation.

4. Mount shields accessible for maintenance.

5. Seal wall penetration watertight.

2.12 TEMPERATURE INDICATORS

A. General: Provide an independent temperature indicator for each sensor, and thermostatic switch except room thermostats. Thus, generally wherever there is a temperature sensor in an air stream there shall be a completely independent mercury-in-glass or dial indicator thermometer, and this shall generally be at the sensor location.

B. Elements: Sensing elements shall be compatible to, and similar to, those of sensors, thermostats and thermostatic switches.

C. Insertion Indicators: Sensing elements for pipes and tanks shall have separable stainless steel or bronze screw wells with heat sensitive liquid in the well.

D. Midpoint Readings: Select indicators with midpoint range readings approximately equal to the normally expected temperature of the measured medium.

E. Types: For local indication provide liquid-in-glass or remote bulb dial type indicators. For remote indication provide sensor-transmitter with remote indicator.

1. Liquid-in-glass indicators shall be remote reading, 7 inches (180 mm) long, bronze or stainless steel casings, rigid stem, adjustable, with stainless steel or bronze screw insertion wells for piping or bolted insertion for air.

2. Remote bulb thermometers shall be not less than 4-inch (100 mm) diameter with stainless steel case and threaded face ring, gasketed, high strength glass cover,

liquid filled copper or monel sensing element and maximum 20 feet (6 m) long capillary and stainless steel bulb retaining clips. Mount dial thermometers not more than 6 feet (1800 mm) above the floor. Mount multiple dial thermometers on common phenolic or painted galvanized steel gauge boards having engraved bolted nameplates. Mount gauge boards free from vibration. Accuracy shall be not less than 1 percent of full-scale range.

F. Sensor-Transmitter-Indicators: Provide sensor-transmitter-indicators where the distance between the sensed point and the indicator exceeds 20 feet. (6 m).

1. Provide transmitters to transduce the measured temperature to a low signal and provide wiring in conduit or pneumatic tubing to a gauge board or panel mounted indicator.

2. Indicator may be of 6-inch (150-mm) diameter dial type or 7-inch (180-mm) vertical scale type.

3. The same sensor-transmitter may not be used for both indicators and controllers.

4. Transmitter-receiver-indicators shall be calibrated after installation to an accuracy of plus or minus one degree F. over full-scale range. (" 0.5EC. over full scale range).

2.13 PRESSURE CONTROLLERS

A. Types: Provide digital electronic pressure controllers of the analog or two-position type as required by the sequence of operation.

2.14 ELECTRIC PRESSURE SWITCHES

A. Type: Provide bourdon tube or diaphragm type electric pressure switches with tamperproof adjustable set point and differential settings. Design switches for 200 percent overpressure and full vacuum underpressure without damage or accuracy impairment.

2.15 PRESSURE INDICATORS

A. Standard: Provide pressure indicators conforming to American National Standards Institute (ANSI) B40.1, "Gauges - Pressure Indicating Dial Type - Elastic Element."

B. Service: Provide gauges suitable for the application on air, steam, oil and water.

C. Accessory: For each gauge provide brass or aluminum case, bronze tube, gauge cock, and pressure snubber.

D. Siphon: For steam application provide a siphon.

E. Range: Select scale ranges for approximately 150 percent of maximum intended service range.

F. Calibration Screw: Provide each flush mounted panel gauge with a calibration screw.

G. Size: Provide minimum 3.5-inch (90-mm) diameter dial gauges for local indication at pumps, tanks and piping. Provide 2-1/2-inch (65 mm) diameter gauges inside local control cabinets for local pressure indication.

H. Location: Provide a pressure indicator at each pressure analog sensor and for each pressure switch and each pressure controlled variable. This shall generally be a standard pressure gauge and shall be independent of the sensor.

2.16 DEW POINT AND RELATIVE HUMIDITY CONTROLLERS

A. Action: Provide pneumatic, electric or digital electronic controllers, which operate in an analog or binary manner, required by the sequence of operation.

B. Public Spaces: Controllers located in public spaces shall be provided with 16 gauge (1.5 mm) ground and polished 316 stainless steel covers or flush 316 mounted stainless steel aspirating boxes with concealed Allen head screws.

2.17 DAMPERS

A. Standards: Provide opposed blade and parallel blade factory fabricated dampers of extruded aluminum, galvanized steel or stainless steel with metallic anti-friction non-ferrous bearing in accordance with Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) standards.

B. Types: Use parallel blade dampers in mixing chambers and plenums. Use opposed blade dampers for volume control, face and bypass dampers, fan discharge, and variable air volume control.

C. Pressure Rating: For fan systems less than 2.5 kPa static pressure, design and construct dampers to withstand a pressure of 1035 kPa without damage, leakage, flexure, or distortion.

D. Leakage: Maximum air leakage rate for all dampers shall not exceed 50 L/s of air per square meter at atmospheric pressure when closed against a 1 kPa static pressure.

E. Operators: Damper operators shall have sufficient power to open and close the dampers and limit the leakage to the specified rate.

F. Shafts and Bearings: Provide cadmium plated steel shafts in permanently lubricated bronze sleeve bearings or permanently lubricated ball bearings.

G. Blade Sizes: Reinforced or ribbed blades shall not exceed 200 mm in width nor 1200 mm in length.

1. Flat or unreinforced blades will not be acceptable.

2. Damper sections exceeding 1200 mm in width or 1200-mm height shall be constructed with multiple frames and linkages.

H. Frames: Construct frames of factory welded galvanized steel hot dipped after construction or bolted extruded aluminum frames.

1. Dampers larger than 0.75 m^2 in area shall have corner-bracing gussets at each corner welded to the damper frame.

I. Linkages: Provide linkages to uniformly transmit damper operating forces to each damper blade.

1. Construct linkages of galvanized or cadmium plated steel or stainless steel.

2. Bearings and joints shall be ball and socket or sleeve bearings of brass, bronze or stainless steel, with plated bolts and locking nuts.

J. Seals: Provide mechanically attached elastomer or neoprene blade tip seal along the full length of each blade edge and flexible stainless steel seals along damper blade ends where the blades abut the frame. Adhesives or staples will not be acceptable.

K. Damper Mounting: Mount dampers to casings and ductwork in conformance with SMACNA standards. Provide welded or bolted galvanized steel structural supports for dampers larger than 1.9 m^2. Through bolt damper frames to structural supports.

2.18 AUTOMATIC VALVES

A. Standards: For chilled water, low temperature hot water and low pressure steam provide valves conforming to ANSI B16.15, "Cast Bronze Threaded Fittings," Class 860 kPa copper bearing steel, bronze, or ANSI B16.1, "Cast Iron Pipe Flanges and Flanged Fittings," Class 860 kPa cast iron. For steam above 170 kPa and any water above 690 kPa provide valves conforming to ANSI B16.5, "Pipe Flanges and Flanged Fittings," cast steel or stainless steel. Select valve pressure class minimum 150 percent of maximum working pressure.

B. End Connections: Provide valves with end connections as follows:

1. For chilled water, low temperature hot water and low pressure steam provide valves with flanged connections on sizes 65 mm and larger and threaded connections on valves 50 mm and smaller.

2. For high-pressure steam provide flange or union connections on valves 40 mm and larger.

C. Small Water Valves: For valves controlling low pressure and low temperature chilled or hot water sizes 25 mm and smaller, bodies shall be bronze, cast iron or stainless steel with screwed, union or flare connections.

D. Valve Trim: Provide valve trim as follows:

1. Stems shall 316 stainless steel.

2. For small valves, disk and stuffing boxes may be bronze or 316 stainless steel.

3. For all valves 40 mm and larger, stems, disks, seats, and stuffing boxes shall be 316 stainless steel.

4. All non-metallic parts of hot water and steam valves shall be designed for minimum 120EC or 40EC above system design temperature, whichever is higher for continuous duty.

5. Leakage: Control valves shall provide tight shut off in the closed position at 150 percent of maximum working pressure.

E. Valve Characteristics: Select valves to provide equal percentage control of water and linear control of steam. Modulating valves for steam shall have V-port skirts, tapered plugs for water.

1. Butterfly valves will not be acceptable for modulating control, [except as specified below].

2. For two position, water application action, butterfly valves may be used, provided the differential pressure across the valve when closed does not exceed 170 kPa.

F. Sizing: Provide valves of sizes indicated, or as herein specified.

1. Size steam valves with a pressure drop not to exceed 50 percent of the total differential between supply and return main at full indicated flow.

2. Size water valves with a maximum differential pressure not greater 3-m or 1/2 the loss through the controlled apparatus, whichever is greater.

G. Actuators: Provide actuators, sized by the manufacturer, of sufficient size and power to operate the valve under all conditions and to close the valve tight against maximum differential pressure.

1. Provide pilots for sequence operations, and cases where valve spring ranges have been increased to close off against system pressure.

2. Comply with requirements of "Actuators" paragraph of this Section.

H. Eccentric Disc Butterfly Control Valves: For modulating control of water and eccentric-disc-type, wedge shaped, butterfly valve shall be used.

1. The disc shall be eccentrically mounted, so that center of rotation is off of the top-to-bottom centerline of the valve body, for better modulating flow control.

2. The disc shall be contoured and wedge shaped on one of the planar surfaces of the disc, such that it is appreciably thicker at the center than at the edges, for better modulating control.

3. Materials and construction shall be as follows: Body: WCB steel (ASTM A216). Disc: WCB steel (A216) with chrome-plated seating surfaces. Seal: either (a) PTFE with 316 stainless steel, or (b) 316 stainless steel. Body: either (a) flangeless for mounting between ANSI flanges and gaskets, or (b) shall have flanges.

4. Eccentric disc butterfly valves shall be as manufactured by Fisher Control Co. of Marshalltown, Iowa, or equal. there are no known equals. In lieu of providing Fisher valve, Contractor may use a global valve or tapered plug valve, however the pressure lift (head) of the pump(s) on the hydronic system shall be increased as necessary to compensate for the higher pressure drop of the alternate valve, in the open position.

5. Actuator: (a) Actuator shall have a pilot positioner. (b) It shall have a handwheel to override the automatic operation. (c) If pneumatic, the actuator Housing and Spring Barrel shall be cast iron or steel. (d) The actuator shall have a minimum 3-pressure gauge arrangement, if pneumatic.

2.19 ACTUATORS

A. General: Provide electric motor driven actuators (operators) arranged "Fail Safe" in the event of power failure. Design operators to be quiet in operation and function within a range 85 to 100 percent input power potential.

B. Electric Actuators: Provide hydraulic or gear type electric actuators.

1. When operated at rated voltage each actuator shall deliver the torque required for continuous uniform movement of the control device from limit to limit.

2. Provide an end switch to limit travel and design the actuator to continuously stroke without damage.

3. Operators shall function properly within a range of 85 to 120 percent of line voltage. For actuators with input power greater than 100 watts, gears shall be ground steel, oil immersed, shaft shall be hardened steel running in bronze, copper alloy or ball bearing and operator and gear trains shall be totally enclosed in dustproof cast iron, cast steel or cast aluminum housing.

4. Actuators with input power less than 100 watts may use fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings and pressed steel enclosures.

5. Two position actuators shall be of the single direction, spring return or reversing type.

6. Proportioning operators shall be capable of stopping at all points in the cycle and starting in either direction from any point.

7. Reversing and proportioning operators shall have limit switches to limit travel in either direction.

8. Electric valve operators shall be equipped with a spring yield device to maintain control pressure on the valve disk when the actuator is in a relaxed position.

9. For actuators with greater than 400 watts input, provide totally enclosed reversible induction motors with auxiliary hand crank and permanently lubricated bearings.

C. Damper Operator Mounting: Mount damper operators where accessible for maintenance.

1. If located outside the duct or casing, mount operators on a 2-mm reinforced support plate arranged to allow insulation between the support plate and the face of the duct or casing.

2. Brace damper operators rigid to show no deflection or movement over the full range of the damper stroke.

2.20 CONTROL PANELS AND CABINETS

A. Local Panels and Cabinets: Provide local control cabinets for each air handling unit, automatically controlled equipment such as pumps, fans, heaters and converters, or groups of such equipment in a single mechanical equipment room.

B. Standards: Construct panels in conformance with UL 50, "Cabinets and Boxes," or similar approved construction, with backbox, full-sized piano hinged face, stainless steel lockable latch, and secure to the building construction.

1. Internally mount all controllers, relays, terminal boards, and miscellaneous control devices, on a removable panel.

2. Flush mount in the door all indicators, selector switches, remote setpoint adjusters, and pilot lights.

3. Cabinet internals may be factory or field wired and piped. Pipe and wire shall be neat, braced, and strapped flat to present a neat appearance and to easily trace wiring and piping from one device to another.

4. Floor mounted panels shall be bolted to 40 mm by 40 mm structural support channel, bolted to the floor and braced at the top.

5. Each panel shall be provided with a lighting fixture permanently attached to panel, with a fireproof lamp shade extending over the entire length of the panel. Lighting fixture shall provide an average illumination of 400 lux over the entire control surface of the panel.

6. Diagrams and devices on local control panels shall be identified with engraved phenolic nameplates, white on black, minimum 1/4-inch high block capital lettering, screwed or bolted to panel or mounting plate face. Control devices shall have the same nomenclature and numbers on the nameplates as on the control diagrams (for instance "EP-3" on diagrams and schedules shall be "EP-3" on nameplate).

2.21 SYSTEM DIAGRAMS

A. Systems Diagrams: Systems diagrams and other material shall be done in a professional manner including, but not limited to, the following requirements:

1. Control diagrams shall include system one-line diagram, system control diagram, narrative sequence of operations, and schedule of control devices.

2. Control diagrams shall have added to them NIMA operating instructions as directed by NIMA.

3. Item names, such as RC-2, shall be consistently identified on diagrams, sequence description, and component schedule.

4. Items, tubing, and wiring numbered and named on the diagrams shall be so identified by tags in field.

5. Where items, functions, operations, and the like are labeled on diagrams as "by others," the diagram shall include the "others' " diagram to gather these together. The "others" diagrams may be on a separate sheet.

6. For pneumatic systems, the diagrams or manuals shall include showing calculations of Percent Throttling Range for each receiver controller, and calculations of Percent Authority if applicable.

7. Diagrams shall have directional arrows on the air pressure or electronic signal paths to aid-operating engineers' understanding of control operation. Normally Open and Normally Closed shall be noted on all appropriate devices, including Electric-Pneumatic switches. Direct Acting and Reverse Acting shall be noted as applicable on appropriate devices, including Receiver Controllers. For Pneumatic-Electric switches, the Cut In and Cut Out pressures shall be noted on the as-built drawings. P.E. switches of the less common type that allow the flow of electricity on the absence of pneumatic air pressure shall be so noted, as Normally Electrically Energized or similar.

B. Mounting: Mount previously approved control diagrams adjacent to each local control panel on a furniture steel extension either bolted to wall or to an extension of the control cabinet structural support.

1. Control diagrams shall include system one-line diagram, system control diagram, sequence of operations and schedule of control devices.

2. Diagrams shall be hermetically sealed in laminated 1.5-mm plastic.

3. Diagrams shall be permanent, black on white background, not subject to fading when subjected to artificial or natural light. Diazo prints are not acceptable. Submit a small number of sample copies in advance for approval of reproduction.

4. Diagrams shall represent the current, "as-built" status of the control system, after acceptance by the representative of the Contracting Officer.

5. Obsolete, out of date, or field modified diagrams shall be removed, and new current diagrams furnished.

6. Diagrams and devices on local control panels shall be identified with engraved phenolic nameplates, white on black, minimum 1/4-inch (6 mm) high block capital lettering, screwed or bolted to panel or mounting plate face. Adhesive attachments are not acceptable.

2.22 WIRING

A. General: Provide a complete system of electric wiring for temperature control apparatus including control power transformers and wiring to the transformer primary.

B. Insulation Level: Control circuit conductors which run in the same conduit as power circuit conductors shall have the same insulation level as adjacent power conductors.

C. NFPA 70: All wiring shall conform to the requirements of the NFPA 70.

1. Wiring shall be run in rigid or flexible conduit, metallic tubing, metallic raceways, or wireways.

2. Aluminum conduit may be used but shall not be buried in concrete.

D. Wiring: Wire for low voltage AC shall be minimum 300 volt insulated copper No. 18 AWG or larger conforming to NFPA 70, Type MTW, THHN or TFFN.

1. Electric switches shall have small neon or other approved type of light, to light when they are electrically energized.

2. For low voltage DC and an electronic circuit carrying less than 0.5 amperes, cables of two or more conductors not smaller than No. 18 AWG solid copper or No. 18 AWG solid copper if not shielded may be used in lieu of individual wires.

3. Cables carrying analog signals shall be shielded.

4. Cables shall be terminated in solder or screw type terminal strips.

5. Cables shall not be tapped at any intermediate points.

6. All wire shall not be color coded or numbered for identification. Identify as indicated on shop drawings and "As-Built" drawings.

7. Wire terminating in screw type terminal strips shall have pressure connectors conforming to UL 486A, "Wire Connectors and Soldering Lugs for Use With Copper Conductors," or UL 486B, "Wire Connectors for Use With Aluminum Conductors."

8. Wire terminations without connectors or travelling pressure pads will not be accepted.

PART 3 - EXECUTION

3.1 PRECONSTRUCTION QUALIFICATION

A. General: Before starting the work the specialist superintendent shall present an approved copy of his qualification submittal.

1. Throughout the installation of automatic control equipment, piping, wiring and other devices, testing, calibration, checkout, and commissioning, the superintendent shall be available on the construction site.

2. Should the construction superintendent specialist be unavailable through sickness or any other reason for more than 8 hours in any 40-hour construction week, a

temporary suspension of the automatic control work, until such time as the pre-qualified specialist or a pre-qualified replacement is available on a full time basis without incurring delay , will be in affect.

3. Should the Contractor elect to provide more than one superintendent specialist then each shall be pre-qualified.

3.2 INSTALLATION

A. Wiring: Provide, wiring and conduit to connect the automatic control system components for an operational system.

1. Provide wiring in accordance with the NFPA 70.

2. Do not bury or conceal wiring beneath insulation.

3. Locate wiring clear of access doors, accessible ceilings, lighting fixtures, walkways, or any location subject to damage or abrasion.

B. Identification: Control panels shall bear the nameplate of the specialist installer with his name and office location, so the entire work can be seen to be a reflection of his professionalism. Label or code each field wire or pneumatic tube at each end, and each controller and controlled device.

1. Identification shall be permanent, robust, not subject to fading, and flameproof.

2. Permanently mark terminal blocks at wire termination points.

3. Identify each control device with an engraved laminated phenolic nameplate, white on black, lettering not less than 3 mm height, on 40 mm by 25 mm tag and brass interlocked chain secured to the control device. Name shall correspond with identification on the shop drawings.

4. Identify sensors, controllers, relays, either mounted in local or central control panels, or remote mounted with a similar name tag as specified above. Attach to or adjacent to controllers with stainless steel or brass screws or rivets. Adhesives will not be acceptable. Do not attach to removable controller covers.

5. The labeling of wiring and tubing throughout the field system installation shall be matched to numbers shown on control diagrams. Wiring and tubing shall be labeled in field where it enters control panels.

C. Pipe Work: Mount strap-on sensors using helical screw stainless steel band clamp for strap-on thermostats, aquastats and other temperature switches on new piping for unit heaters and fan coil units after the pipe is cleaned to bright metal. Strap-on sensor may be used on piping up to 2-1/2-inch (65-mm) diameter. On pipe 3 inches (80 mm) and larger use pipe wells.

D. Pipe Wells: Install pipe wells above the horizontal to retain liquid heat transfer fluid in the well.

E. Valves: Install valves in piping with stems as vertical as possible but in no case less than 45 degrees (0.785 (π/4) rad) from vertical. For soldered or welded connections, remove valve internals before mounting.

F. Electric Valves: Wire electric valves in accordance with NFPA 70 with not less than 2 feet (600 mm) of flexible liquidtight connector with watertight bushings at the valve actuator. Brace conduit to the building structure.

G. Pressure and Temperature Sensors: Install pressure and temperature sensors as follows.

1. Locate pressure and temperature sensing points sufficiently downstream from the control device to increase control loop time constant and minimize hunting.

2. Locate shut-off valves and 3-valve bypasses as specified in "Sensors" paragraph of this Section.

3. Locate sensors where accessible for maintenance and replacement.

4. Do not cover or conceal sensors with insulation.

H. Space Sensors: Install space sensors as follows.

1. Space sensor including space thermostats, aspirating thermostats, humidistats, pressure or differential pressure sensors shall be enclosed in cast brushed aluminum or 16 gauge (1.6 mm) brushed and ground stainless steel enclosures. Enclosures shall be tamperproof. Setpoint adjustment or settings shall not be visible or adjustable from outside sensor enclosure. Sensors shall be securely mounted and rigid.

2. Locate room thermostats and other room sensors approximately 1500 mm above the floor on inside wall where they will respond to average conditions in the space.

3. Sensors mounted on outside walls, if unavoidable, shall be mounted on factory made insulated brushed stainless steel bases.

I. Air Handling Unit Temperature Indicators: For each factory assembled central station air handling unit and field erected air-handling unit, provide temperature indicators in the following locations.

1. Each outside air plenum.

2. Each return air plenum.

3. Each Return-Air/Outdoor-Air mixed air chamber (normally pre-heat coil inlet).

4. Each cooling coil inlet and discharge.

5. Each heating coil discharge.

6. The above indicator requirements do not apply to roof top equipment, self-contained computer room equipment or room terminal units.

7. Temperature indicators shall be so located that they may be read by an operator standing on the operator floor. Indicators more than 2400 mm above the floor shall be remote bulb type.

J. Signal Indicators:

1. Provide each controller inside field cabinets with instrumentation, pressure gauges, voltmeters or millimeters to show the following conditions at the controller locations. Indicators shall be permanently mounted.

2. Gauges shall be provided for all static air pressure signals brought back to panel; these shall be Magnehelic or Minihelic or equal.

3. Static air pressure signals routed to Air Handling Units, etc., for control of vortex dampers, variable drive motors, and the like shall be provided with 100 mm Magnehelic gauges at or near the AHU.

K. Duct Sensors: Select duct sensor locations to properly sense average air conditions, minimize vibration, avoid dead air spaces, and within velocity limits required by the manufacturer.

1. Provide velocity shields where required.

2. Securely mount or clamp averaging elements, maximum 1 m on centers to the leaving side of coils and equipment. Insulate averaging elements from equipment and protect from vibration.

3. Provide separate duct flanges for each sensing device.

4. Provide gaskets or sealant where elements penetrate duct walls.

5. Mount sensor to allow easy removal and servicing without disturbing insulation or vapor barrier. Mount on stand off brackets to avoid condensation.

6. Coordinate the location for duct access doors downstream from each duct sensor.

L. Pipe Sensors: Provide wells for all sensors and indicators measuring temperatures in pressure vessels and piping.

1. Wells shall be stainless steel or bronze to match media requirements.

2. Verify working pressure of sensor wells.

3. Do not install wells in extension couplings.

4. Where pipe diameters are smaller than the well length, provide wells at piping elbow or tees to affect flow across the entire well area.

5. Wells may face upstream or downstream.

6. Angle wells to retain thermal fluid within the well.

7. Should wells restrict cross sectional pipe area to less than 70 percent free area, provide pipe increases at the well not less than 150 percent pipe diameter.

2.3 TEST PLAN

A. Test Plan: Prepare a written test plan indicating in a step-by-step, logical fashion, the procedures by which the automatic control system will be tested, adjusted, and checked.

B. Pre-Approval: Not less than 6 weeks prior to testing, provide four copies of the proposed test plan for approval. Meet and discuss the test plan, and make agreed changes to the written plan.

C. Content: Plan shall include, as a minimum, for each system and sub-system of the automatic control work the following:

1. System name.

2. List of devices with brief description of functional purpose of each.

3. A description of the expected signal values transmitted by the sensor.

4. A description of the expected signal values transmitted by the controller to the control device or actuator.

5. A description of the expected values of the control medium from limit-to-limit.

6. A description of the instrumentation required to test the system.

7. A description of the expected field adjustments for transmitter, controller, and control actuator should control parameters fall outside of expected values.

8. A log sheet or sheets on which expected and field read values will be recorded and final field read values indicating that the system is operating in accordance with contract requirements.

3.4 TESTS DURING AND AFTER INSTALLATION

A. Instrumentation and Control: Calibration test each controller as follows:

1. Disconnect the sensor-input signal to the controller and provide a compatible test signal generator.

2. Simulate expected transmitter values and input to the controller. Record controller branch line values.

3. Examine control device and determine that the device is responding.

4. Simulate maximum and minimum transmitter signal values and verify minimum and maximum controller output values and control device minimum and maximum stroke range.

5. Record all values and recalibrate controller as necessary to conform with specified control ramps, reset schedule, proportional relationship, reset relationship, and derivative reaction.

6. When the controller and control device portion of each loop are responding as designed, reconnect the sensor transmitter input line.

7. After mechanical equipment control becomes operational, perform an operational test of each control loop recording sensor, transmitter, controller input, controller output and control medium parameter.

8. Entire test shall be witnessed (refer to Division 1).

9. Upon satisfactory test a copy of final test results shall be bound in the operating and maintenance manual.

3.5 COMMISSIONING TESTS AND VERIFICATION

A. General: In addition to the tests required during and after installation of automatic control systems, the Contractor shall perform commissioning tests to verify that the entire automatic control systems are designed, installed, and adjusted to perform as required in the Contract. This phase is an extension, not a substitute, of the phase specified under the "Tests During and After Installation" article of this Section.

B. Calibration of Sensors and Verification of Control Operations: Demonstrate all calibration and tests specified in paragraphs "Instrumentation and Control" paragraph under "Tests During and After Installation" article of this Section, to the commissioning team.

C. Verify each and every control sequence specified in Part 2 of this Section.

D. Verification of Electronic Digital Controllers:

1. Verify the operation of microcomputer operating system of the field panels. Demonstrate proper automatic restart of equipment after power restoration.

2. Verify each and every required application software. They shall include, but not be limited to:

   a. All control sequences specified for each local loop
   b. Time of day scheduling
   c. Economizer control
   d. Supply air reset
   e. Chilled water reset
   f. Outdoor air reset
   g. Zero energy band program
   h. Unoccupied cycle.

3. Verify the operation of the operator's keypad, including levels of security to access the keypad, as specified in "Field Panel: Operator's Keypad" paragraph of Part 2 of this Section.

4. Verify self-diagnostics of field panel and annunciation of malfunctions at the central computer. Demonstrate activation of diagnostics from local operator's keypads. Each field panel shall be verified.

5. Verify the operation of the clock routine in the field panel and resetting of field panel clock by central computer.

6. Verify the operation of the intrusion alarm of field panel.

7. Demonstrate changing of default values of sensors through local keypads.

8. Demonstrate proper system operation while setpoints and data are being modified.

E. System Accuracy: System accuracies for each control loop, from end-to-end, shall be no less than those listed in "System Accuracy" paragraph under "Controllers" article of Part 2 of this Section.

F. Witnessing of Tests : All commissioning tests, verifications, and demonstrations shall be witnessed by the commissioning team.

G. Failure of Tests: Any test, verification, or demonstration fails to meet the specification requirements, the component of the automatic control system causing the control system failure, be it hardware, firmware, or software, shall be repaired, replaced, or readjusted. The failed test, verification, or demonstration shall be repeated.

H. Test Report: Upon satisfactory tests of the automatic control systems, a copy of final test results shall be bound in the operating and maintenance manual.

3.6 DEMONSTRATION AND TRAINING

A. Demonstration: After completion of testing as hereinbefore specified, provide demonstration and training of designated operating personnel (refer to Division 1).

1. Demonstration shall be performed.

2. Demonstration shall include the operation of the entire mechanical system under the control of the Contractor and shall include the start-up, operation, and shutdown of the system in accordance with the sequence of operation.

3. The operation of each device shall be performed in accordance with the written instructions contained in the operation and maintenance manual, a copy of which shall be available 10 working days prior to the test. No deviation from procedures in the operating manual will be permitted.

B. Failure to Perform: Should the system fail to perform in accordance with the requirements of the operation and maintenance manual, the system shall be repaired, recalibrate, retested as necessary, and a second demonstration performed.

1. Subsequent demonstrations shall occur until the automatic control system and all associated mechanical and electrical equipment are operating in accordance with contract requirements.

2. All testing, retesting, and recalibration shall be at no additional expense. The Contractor shall reimburse the expenses of the commissioning team for each test after the first.

3.7 INSTRUCTING OPERATING PERSONNEL

A. Instructors and Superintendent: Upon completion of the work and acceptance by the representative of the Contracting Officer, provide the services of an Instructor, who together with the superintendent specialist shall instruct designated operating personnel in the operation and maintenance of the automatic control system.

1. The services of the Instructor shall be available for not less than four 4-hour days of instruction.

2. The services of the superintendent specialist shall be available for not less than two 4-hour days.

3. Instructions shall be based upon the use of the operating and maintenance manual together with copies of the laminated control diagrams affixed adjacent to each local control panel.

4. Training and instruction will be witnessed. The witness shall monitor the entire training program, prepare a written report on the competency and effectiveness of instructors and the level of expertise of designated operators. A report will be submitted recommending additional training at additional cost, if such is deemed necessary.

5. Instruction shall be given on the following items:

a. Calibration and adjustment of various devices, and how to change set points, deadbands, throttling ranges, etc., from initial set up.

b. How to calculate and set Percent Throttling Range, and Percent Authority, if applicable.

END OF SECTION 15950

SECTION 15990 - TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Extent of testing, adjusting and balancing work required by this Section is indicated on the drawings, in schedules, and by the requirements of this Section, and Section 15010 "Mechanical Basic Requirements."

B. Systems: Testing, adjusting and balancing specified in this Section includes the following systems.

1. Air handling systems including supply return and exhaust.
2. Hydronic system including heating and chilled water .

C. Related Sections: Refer to other Division 15 sections for:

1. Fans
2. Air Terminal Units
3. Hydronic Piping Systems
4. Sheet Metal Ductwork

1.2 QUALITY ASSURANCE

A. Tester's Qualifications: A specialist certified by the National Environmental Balancing Bureau (NEBB) or Associated Air Balance Council (AABC) with at least 3 years of experience in those testing, adjusting and balancing requirements similar to those required for this project, who is not the installer of the system to be tested and is otherwise independent of the project.

B. Tester's Qualifications: A specialist certified by the NEBB or AABC with at least 3 years of experience in those testing, adjusting and balancing requirements similar to those required for this project, and who is also the original installer of the system to be tested.

C. Codes and Standards: Provide testing, adjusting and balancing conforming to American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), American National Standards Institute (ANSI), and either NEBB or AABC the following:

1. American National Standards Institute (ANSI): Comply with the following:

   a. S1.4 Specification For Sound Level Meters

   b. S1.11 Specification for Octave-Band and Fractional-Octave-Band Analog and Digital Filters

2. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE): Comply with ASHRAE recommendations pertaining to measurements, instruments, and testing, adjusting, and balancing.

3. NEBB or AABC: Comply with NEBB'S "Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems" or comply with AABC MN-1 "National Standards," as applicable to mechanical air and hydronic distribution systems, and associated equipment and apparatus, except as follows (unless more stringent requirements are specified elsewhere):

   a. For water flow quantities, flow through pumps, chillers, and through coils of 0.6 L/s and higher shall be adjusted as close to specified design flow as possible, with no more divergence than plus or minus 5% of design flow.

   b. For air flow quantities, flow through fans shall be adjusted as close to specified design flow as possible, with no more vigergence than plus or minus 2% of design flow, however flows through air terminals may be within 10% as allowed by AABC and NEBB.

   c. Entering air temperatures and entering water temperatures of air-handling units, packaged a/c units, chillers, and the like shall be maintained at steady state to within plus or minus 0.5 degree C. of specified design entering conditions.

D. Penalty: The Contractor shall submit the name of the organization he proposes to employ for approval within 30 days after contract award. If the Contractor fails to submit the name of an acceptable agency within the specified time, a firm may be selected to accomplish the work, and this selection shall be binding upon the Contractor at no additional cost.

E. Calibration of Testing Instruments: All measurement instruments used for testing, adjusting, balancing, and commissioning shall be calibrated. The time between the most recent calibration data and the final test report date shall not be over 3 years.

1.3 SUBMITTALS

A. Division 1: Conform to the requirements of Division 1, Section 01003, "Submittals."

B. Test Reports: Provide certified test reports, signed by the test and balance supervisor who performed the work. In addition, have the reports certified by a Professional Engineer who is familiar with testing and balancing and the project, and is registered in the jurisdiction where testing is being conducted. The final reports shall include identification and types of instruments used, and their most recent calibration date and calibration date.

C. Standards: The Contractor shall provide one copy on loan until contract close-out of either NEBB or AABC standards for testing and balancing work associated with the project. This document shall serve as specific guidance to construction engineers as to minimum requirements. The copy of the AABC or NEBB manual shall initially be turned over with the Agenda submission specified below.

D. Maintenance Data: Include, in maintenance manuals, copies of certified test reports and identification of instruments.

E. Qualifications: The Contractor shall submit the certified individual qualifications of all persons responsible for supervising and performing the actual work, the name of the certifying engineer, and the qualifications of the independent Registered Professional Engineer certifying the report.

1.4 AGENDA

A. Agenda: A preliminary report and agenda shall be submitted and approved prior to the start of testing and balancing work.

1. Review plans and specifications prior to installation of any of the affected systems, and submit a report indicating any deficiencies in the systems that would preclude the proper adjusting, balancing, and testing of the systems.

2. The agenda shall include a general description of each air and water system with its associated equipment and operation cycles for heating, intermediate, and cooling.

3. The agenda shall include a list of all air and water flow and air terminal measurements to be performed.

4. The agenda shall incorporate the proposed selection points for sound measurements, including typical spaces as well as sound sensitive areas like conference rooms.

5. The agenda shall also include specific test procedures and parameters for determining specified quantities (e.g. flow, drafts, sound levels) from the actual field measurements to establish compliance with contract requirements. Samples of forms showing application of procedures and calculations to typical systems shall be submitted.

6. Specific test procedures for measuring air quantities at terminals shall specify type of instrument to be used, method of instrument application (by sketch) and factors for:

a. Air terminal configuration.

b. Flow direction (supply or exhaust).

c. Velocity corrections.

d. Effective area applicable to each size and type of air terminal.

e. Density corrections.

7. The agenda shall include identification and types of measurement instruments to be used, and their most recent calibration date and calibration date.

1.5 JOB CONDITIONS

A. General: Do not proceed with testing, adjusting and balancing work until the following conditions have been met.

1. Work has been completed and is operable. Ensure that there is no latent residual work yet to be completed on the tested equipment.
2. Work scheduled for testing, adjusting and balancing is clean and free from debris, dirt and discarded building materials.

3. All architectural openings (doors, windows, and other openings) which may affect the operation of the system to be tested, adjusted, and balanced shall at their normal states.

4. All related mechanical systems, which may affect the operation of the system to be tested, adjusted, and balanced shall be at their normal operating conditions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (Not Used)

2.2 PATCHING MATERIALS

A. Material: Seal, patch and repair ductwork, piping and equipment drilled or cut for testing purposes.

1. Plastic plugs with retainers may be used to patch drilled holes in ductwork and housings.

2. Piping shall be capped with materials the same as the piping system.

3. Insulation shall be neatly hemmed with metal or plastic edging, leaving test points visible for future testing.

2.3 TEST INSTRUMENTS

A. Standards: Utilize instruments and equipment of type, precision, and capacity as recommended in the following standards:

1. NEBB "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."

2. AABC Manual MN-1.

B. Test Instruments: All instruments used for measurements shall be accurate and calibration histories for each instrument shall be available for examination. Each test instrument shall be calibrated by an approved laboratory or by the manufacturer. A representative has the right to request instrument recalibration, or the use of other instruments and test methodology, where accuracy of readings is questionable.

C. Additional Instruments: Permanently installed measuring instruments , such as temperature and pressure gauges, shall be checked against transfer standard instruments. Any instrument, which does not meet specification requirement, shall be replaced or recalibrated.

D. Cone Instruments: The Contractor shall employ manufactured enclosure type cones, capable of air volume direct readings, for all diffuser airflow measurements. The readout meters shall meet calibration requirements.

PART 3 - EXECUTION

3.1 PROCEDURES AND INSTRUMENTS, GENERAL

A. Requirements: All systems and components thereof shall be adjusted to perform as required by drawings and specifications.

B. Test Duration: Operating tests of heating and cooling coils, fans, and other equipment shall be of not less than four hours duration after stabilized operating conditions have been established. Capacities shall be based on temperatures and air and water quantities measured during such tests.

C. Instrumentation: Method of application of instrumentation shall be in accordance with the approved agenda.

1. All instruments shall be applied in accordance with the manufacturers certified instructions.

2. The Contractor shall furnish all labor, instruments, and appliances required. Permanently installed instruments used for the tests (e.g., flow meters and energy meters) shall not be installed until the entire system has been cleaned and ready for operation.

3. See Section 15130, "Meters and Gauges" for thermometer accuracy requirements.

3.2 AIR SYSTEM PROCEDURES

A. Adjustments: Adjust all air handling systems to provide approximate design air quantity to or through, each component, and to maintain stable and comfortable interior temperatures, free of drafts or stagnant conditions. Adjusting and balancing of all systems shall be conducted during periods of the year approximating maximum seasonal operation.

B. Equalizers: Equalizing devices shall be adjusted to provide uniform velocity across the inlets (duct side for supply) of terminals prior to measuring flow rates.

C. Balance: Flow adjusting (volume control) devices shall be used to balance air quantities (i.e., proportion flow between various terminals comprising system) to the extent that their adjustments do not create objectionable air motion or sound (i.e., in excess of specified limits).

1. Balancing between runs (submains, branch mains, and branches) generally shall be accomplished by flow regulating devices at, or in, the divided-flow fitting.

2. Restriction imposed by flow regulating devices in or at terminals shall be minimal. Final measurements of air quality shall be made after the air terminal has been adjusted to provide the optimum air patterns of diffusion.

D. Fan Adjustment: Total air system quantities, generally, shall be varied by adjustment of fan speeds or axial-flow fan wheel blade pitch. Damper restriction of a system's total flow may be used only for systems with direct-connected fans (without adjustable pitch blades), provided system pressure is less than 1/2-inch W.G. (0.12 kPa) and sound level criteria is met.

E. Air Measurement: Where air quantity-measuring devices are specified in other sections such systems shall be used as a crosscheck of portable measuring equipment.

1. Except as specifically indicated herein, pitot tube traverses shall be made of each duct to measure airflow therein. Pitot tubes, associated instruments, traverses, and techniques shall conform to the ASHRAE "Handbook of Fundamentals."

2. For ducts serving modular office areas with movable partitions, which are subject to change, pitot tube traverses may be omitted provided the duct serves only a single room or space and its design volume is less than 2000 cfm. (950 L/s). In lieu of pitot tube traverses, airflow in the duct shall be determined by totaling volume of individual terminals served, measured as described herein.

3. Where duct's design velocity and air quantity are both less than 1000 (fpm/cfm), (425 L/s and 5 m/s), air quantity may be determined by measurements at terminals served.

F. Test Holes: Test holes shall be in a straight duct, as far as possible downstream from elbows, bends, take-offs, and other turbulence generating devices, to optimize reliability of flow measurements.

G. Air Terminal Balancing: Generally, measurement of flow rates by means of velocity meters applied to individual terminals, with or without cones or other adapters, shall be used only for balancing. Measurement of air quantities at each type of air terminal (inlet and outlet) shall be determined by the method approved for the balancing agenda. Laboratory tests shall be conducted to prove of methodology when so directed. Such tests shall be conducted in conformance with applicable ASHRAE or American Society of Mechanical Engineers (ASME) codes and shall be made at no cost.

H. Air Motion: Air motion and distribution shall be as specified and indicated on drawings. The Contractor at no additional cost shall, in addition to air motion measurements, make smoke tests wherever requested to demonstrate the air distribution from air terminals.

3.3 WATER SYSTEM PROCEDURES

A. Adjustment: All heating, cooling and condensing water systems shall be adjusted to provide required quantity to or through each component.

B. Metering: Water quantities and pressures shall be measured with calibrated meters.

1. Venturi tubes, orifices, or other metering fittings and pressure gauges shall be used to measure water flow rates and balance systems. Systems shall be adjusted to provide the approved pressure drops through the heat transfer equipment (coils [except room units], converters, etc.) prior to the capacity testing.

2. Where flow metering fittings are not installed, in air/water type heat transfer equipment, flow balance shall be determined by measuring the airside energy

differential across the heat transfer equipment. Measurement of water temperature differential shall be performed with the air system, adjusted as described herein, in operation.

C. Automatic Controls: Automatic control valves shall be positioned for full flow through the heat transfer equipment of the system during tests.

D. Flow: Flow through bypass circuits at three-way valves shall be adjusted to equal that through the supply circuit, when the valve is in the bypass position.

E. Distribution: Adjustment of distribution shall be effected by means of balancing devices (cocks, valves, and fittings) and automatic flow control valves as provided; service valves shall not be used.

1. Where automatic flow control valves are utilized in lieu of Venturi tubes, only pressure differential need be recorded, provided that the pressure is at least the minimum applicable to the tag rating.

F. Special Procedures: Where available pump capacity (as designed) is less than total flow requirements of individual heat transfer units of system served, full flow may be simulated by the temporary restriction of flow to portions of the system; specific procedures shall be delineated in the agenda.

3.4 Heat Exchanger Capacity Verification

A. Air coil capacities shall be verified from airside measurement data. Capacities of coils shall be the difference of the energy carried by the air between the up stream and down stream of the coils.

B. The measured air flow rate for the fan may be used for air coil capacity calculations providing no ducted bypassing of coil is occurring.

C. Steam/water heat exchanger capacity shall be verified by measuring the flow rate and temperature differential of the water.

D. Capacity verifications shall be performed after air and water systems have been balanced. Heat exchangers using steam as the exchange medium shall have the steam measured and adjusted to the specified pressure.

E. False load shall be applied if the upstream air or water does not meet the specified conditions at the time of test.

3.5 SOUND TEST PROCEDURES

A. Scope: Tests of sound levels shall be made at each selection point included in the agenda.

B. Timing: Sound level measurements shall be taken at times when the building is unoccupied, or when activity in surrounding areas and background noise level in areas tested are at a minimum and relatively free from sudden changes in noise levels.

1. Measurements shall be taken with all equipment turned off, except that being tested.

2. The required sound levels shall be measured at any point within a room not less than 6 feet (1800 mm) from an air terminal or room unit, and not closer than 3 feet (900 mm) from any floor, wall, or ceiling surface.

C. Meters: Sound levels shall be measured with a sound meter complying with ANSI S1.4. The "A" scale shall be used to measure over all sound levels. To determine the specified octave band levels, the above sound level meter, set on "C" scale, shall be supplemented by an octave band analyzer complying with ANSI S1.11.

D. Equipment Components: The "Equipment Component" of room sound equals LPt-C. The "Equipment Component" of room sound (noise) levels shall be determined for each of eight octave bands as follows.

1. Measure room sound pressure level "LPb" with equipment to be tested shut off.

2. Measure room sound pressure level "LPt" with equipment to be tested turned on.

3. Calculate LPt-LPb; if this value is less than 1, applicable test must be rerun with lower background level (LPb) unless LPt is within sound pressure level specified for equipment.

4. Determine "c" from the table below:

LPt-LPb (db)	c (db)
1	7
2	4
3	3
4 to 4-1/2	2
5 to 5-1/2	1-1/2
6 to 7-1/2	1
8 to 12	1/2
over 12	0

3.6 CERTIFIED REPORTS

A. Submittals: Three copies of the reports described herein, covering air and water system performance, air motion (fpm),(m/s), and sound pressure levels, shall be submitted prior to final tests and inspection.

B. Instrument Records: Types, serial numbers, and dates of calibration of all instruments shall be included.

C. Reports: Reports shall conspicuously identify items not conforming to contract requirements, or obvious maloperation and design deficiencies.

D. Certification: The reports shall be certified by an independent Registered Professional Engineer who is versed in the field of air and water balancing and who is not affiliated with any firm involved in the design or construction phases of the project. Certification

shall include checking of adherence to agenda, of calculations, of procedures, and evaluation of final summaries.

3.7 AIR SYSTEM DATA

A. Report: The certified report shall include for each air handling system the data listed below.

1. Equipment (Fan or Factory Fabricated Station Unit):

a. Installation data

1) Manufacturer and model

2) Size

3) Arrangement, discharge and class

4) Motor kW, voltage, phase, cycles, and full load amps

5) Location and local identification data

b. Design data

1) Data listed in schedules on drawings and specifications.

c. Fan recorded (test) data

1) cfm (L/s)
2) Static pressure
3) rpm
4) Motor operating amps motor operating kW

2. Duct Systems:

a. Duct air quantities (maximum and minimum) - main, submains, branches, outdoor (outside) air, total air, and exhaust

1) Duct size(s)

2) Number of Pitot tube (pressure measurements)

3) Sum of velocity measurements (Note: Do not add pressure measurements)

4) Average velocity

5) Recorded (test) cfm design cfm (L/s)

b. Individual air terminals

1) Terminal identification supply or exhaust, location and number designation

2) Type size, manufacturer and catalog identification applicable factor for application, velocity, area, etc., and designated area

3) Design and recorded velocities- fpm (m/s) (state "core," "inlet," etc., as applicable)

4) Design and recorded quantities – cfm (L/s) deflector vane or diffusion cone settings

3.8 WATER SYSTEM DATA

A. Report: The certified report for reach water system shall include the data listed below.

1. Air Heating and Cooling Equipment:

a. Design data

1) Load in W or kW

2) cfm (L/s)

3) Entering and leaving water temperature

4) Entering and leaving air-conditions (DB and WB)

5) gpm (L/s)

6) Water pressure drop

b. Recorded data

1) Type of equipment and identification (location or number designation)

2) Entering and leaving air-conditions (DB and WB)

3) Entering and leaving water temperatures

4) gpm (L/s) (if metered) Temperature rise or drop

3.9 SOUND LEVEL DATA

A. Report: The certified report shall record data on sound levels, taken at each selected location, as follows.

1. Source of sound and location

2. Diagram or description of relationship of sound source to measuring instrument

3. "A" scale readings equipment being tested turned off (ambient) equipment being tested turned on (operating conditions)

4. Readings at each specified octave band frequency equipment being tested turned off (ambient) equipment being tested turned on (operating conditions)

5. "Equipment Components" of sound (noise) levels with applicable calculations per "Sound Test Procedures"

6. Graph showing relationship between pressure levels specified and recorded readings

B. Retest: Subsequent to any correctional construction work, such as acoustic corrections, measurement shall be made to verify that associated air and water quantities, as previously measured, have not been disrupted.

1. Certified report shall record all sound data, and their locations, after final adjustments of air and water systems involves.

3.10 FINAL COMMISSIONING TESTS, INSPECTIONS AND ACCEPTANCE

A. Scope: Test shall be made to demonstrate that capacities and performance of air and water systems comply with contract requirements.

1. At the time of final inspection, the Contractor shall recheck, random selection of data (water and air quantities, air motion, and sound levels) recorded in the certified report. In addition, all courtrooms, auditoriums, and conference rooms shall be rechecked.

2. Points and areas for recheck shall be selected by the commissioning team.

3. Measurement and test procedures shall be the same as approved for work forming basis of certified report.

4. Selections for recheck (specific plus random), in general, will not exceed 25 percent of the total number tabulated in the report, except that special air systems may require a complete recheck for safety reasons.

B. Retests: If random tests elicit a measured flow deviation of 10 percent or more from, or a sound level of 2 db or more greater than, that recorded in the certified report listings, as 10 percent or more of the rechecked selections, the report shall be automatically rejected. In the event the report is rejected, all systems shall be readjusted and tested, new data recorded, new certified reports submitted, and new inspection tests made, all at no additional cost. Retainage time shall be based on the date of the final acceptance of the certified report.

C. Marking of Settings: Following final acceptance of certified reports, the settings of all valves, splitters, dampers, and other adjustment devices shall be permanently marked by the Contractor so that adjustment can be restored if disturbed at any time. Devices shall not be marked until after final acceptance.

END OF SECTION 15990

SECTION 16010 - ELECTRICAL BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Extent of electrical work covered by this Section is specified in all other sections of Division 16, the drawings, schedules and by requirements of this Section.

B. Division 1: Refer to Division 1 sections for additional electrical requirements including:

1. Summary of the Work.
2. Project Coordination.
3. Definitions and Standards.
4. Submittals.
5. Schedules and Reports.
6. Products.
7. Project Closeout.

C. Refer to Division 15 sections for work furnished under Division 15 and installed, connected and tested under Division 16. Work includes, but is not limited to:

1. Motors - single-speed, two-speed, part winding and star-delta types.

2. Float and Pressure Switches, alarms and control power stations.

3. Solenoid Valves, motorized valves and damper operators

1.2 QUALITY ASSURANCE

A. Labels and Listings: Refer to Division 1 section, "Products," "Labels and Listings" paragraph, for requirements that materials, appliances and equipment provided meet the requirements of the Underwriters Laboratories, Inc. (UL), Electrical Testing Laboratories (ETL) and other standards organizations.

B. National Fire Protection Association (NFPA): All work provided under this Contract shall meet the requirements of NFPA 70, "National Electrical Code," latest edition.

C. Current Models:

1. Manufactured items furnished shall be the current, cataloged product of the manufacturer.

2. Replacement parts shall be available.

3. There shall be a permanent service organization maintained or trained by the manufacturer to provide satisfactory service.

D. Experience: Manufactured items shall have been installed and used, without modification, renovation or repair, on other projects for not less than three years prior to the date of bid opening for this project.

1.3 SUBMITTALS

A. Division 1: Conform to the requirements of Division 1, Section 01003, "Submittals."

B. Submittal List: Items for which submittals are required are included in each section of Division 16. In addition, provide submittals on the following:

1. Diesel engine generator sets
2. Underfloor raceways
3. Cable trays
4. Medium-voltage load interrupter switches
5. Secondary disconnect and current transformer cabinets
6. Transformer supervisory
7. Panelboards clock system
8. Fire and sprinkler alarm systems
9. Automatic transfer switches
10. Busways
11. Switchgear and switchboards
12. Network protectors
13. Transformers
14. Primary and secondary unit substations systems motor control centers switches - larger than 100 amperes
15. Security alarm systems
16. Radio, sound and television equipment
17. Raceways
18. Raceway fittings
19. Transformer vibration
20. Switches - 100 amperes
21. Motor starters

22. Lighting fixtures

23. Lightning protection

24. Underground conduits

25. Wires and cables

26. Batteries and charging equipment isolation

27. Wiring devices and wall and smaller plates

28. Motors

C. Submit “Coordination Drawings” per the requirements of para. 1.11 “Coordination” of this Section.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Refer to Division 1 section, "Products," paragraph, "Delivery, Storage and Handling," for the requirements of material and products to be delivered to the project site.

B. Storage: Materials stored at the project site which become soiled with construction dirt, concrete or earthwork shall be washed, cleaned and dried or removed from the project site and replaced with new. Do not install soiled material.

C. Cleaning: Clean and wipe the interior of conduit, pullboxes and panelboard backboxes, soiled by masonry trades, before proceeding with wiring.

D. Generally, do not install damaged, broken or marred material or products, replace with new. On long delivery items which are damaged in shipping or storage, field repair may be authorized instead of replacement. Repair authorization shall be written.

1.5 LABELS AND NAMEPLATES

A. Division 1: Conform to Division 1 section, "Products," paragraph, "Labels and Nameplates" for all work furnished under this Division.

B. Manufacturer's Nameplates: Nameplates on manufactured items shall be aluminum or type 304 stainless steel sheet, not less than 20 USG, (.9 mm), riveted or bolted to the manufactured item, with nameplate data engraved or punched to form a non-erasable record of equipment data.

C. Field Installation: Field-installed nameplates shall be engraved melamine plastic laminate, 1/8-inch (3 mm) thick, engraved in block capital lettering to expose white lettering on black face.

D. Size: Labels 20 square inches (12 900 $mm^{2)}$ and less may be 1/16-inch (1.5 mm) thick. Secure labels with rivets, stainless steel bolts, stainless steel strap or supporting angle. Use adhesive where mechanical fasteners cannot be used.

E. Approval: Submit a schedule of nameplates, abbreviations and equipment designations for approval.

1.6 MAINTENANCE AND OPERATING MANUALS

A. Division 1: Conform to the requirements of Division 1 section, "Project Closeout," "Operating and Maintenance Manuals," paragraph for all manuals and operating information required under Division 16.

B. Field Installed Schedules: Conform to the requirements of Division 1 section, "Project Closeout," "Posted Operating Instructions" paragraph for all diagrams, charts, schedules and operating information required for Division 16.

C. Instructions: Conform to the requirements of Division 1 section, "Project Closeout," "Instructions to Government Employees," paragraph for all work furnished under Division 16. Examine each section of Division 16 for instruction, training and operating manual requirements.

1.7 SUBSTITUTIONS AND GENERAL REQUIREMENTS

A. Division 1: Conform to the requirements of Division 1 section, "Products," "General Requirements of Electrical Work," and "Substitutions" paragraphs.

1.8 TEMPORARY FACILITIES

A. Division 1: Refer to Division 1 section, "Temporary Facilities," for the requirements of temporary power and lighting for construction and safety.

B. Conform to Division 1 section, "Temporary Facilities," "Electrical Facilities," paragraph for the grounding requirements of electric welding equipment.

1.9 RENOVATION PROJECTS

A. Demolition: Provide disconnection, demolition and renovation work specified under Division 16 and as indicated and scheduled on the drawings.

B. Damage: Where conduit and wiring to remain are inadvertently damaged or disturbed, cut out and remove damaged portion and all damaged wiring from the source switchboard, panelboard or pullbox to the destination connection point. Provide new wiring of equal capacity.

C. Accessible Work: Exposed conduit to be demolished shall be removed in its entirety.

D. Wiring: Wiring to be demolished shall be removed from both concealed and exposed conduit. No wiring which becomes unused as a result of the Contract shall be abandoned in place.

E. Abandoned Work: Concealed conduit, abandoned in place, shall be cut out approximately two inches beyond the face of adjacent construction, plugged, and the adjacent surface patched to match existing.

F. Removal: Equipment specified or indicated to be demolished, shall be removed from the project site and shall not be reused.

G. Temporary Disconnection: Equipment required to be temporarily disconnected and relocated shall be carefully removed, stored, cleaned, reinstalled, reconnected and made operational.

1.10 SIZING

A. Capacity: Provide equipment and material of sizes, capacities, horsepowers, power ratings and dimensions indicated on the drawings, in the schedules and as specified.

B. Fit and Clearance: Equipment and material of greater or larger power, dimensions, capacity and ratings may be furnished provided such proposed equipment is approved in writing and feeders, circuit breakers, conduit, motors, bases and equipment spaces are increased by the Contractor at no additional cost.

1.11 COORDINATION

A. Coordinate electrical work with that of other trades so that:

1. Interference between general construction, mechanical, electrical, structural and other specialty trades is avoided.

2. Maintain clearances and advise other trades of clearance requirements for operation, repair, removal and testing of electrical equipment.

3. Indicate aisleways and accessways required on coordinated shop drawings for boiler plants, mechanical equipment rooms, computer rooms, laboratories and kitchens.

4. All electrical materials and equipment shall be kept as close as possible to ceiling, walls and columns to occupy the minimum amount of space.

5. Furnish and install all offsets, fittings and similar items necessary to accomplish the requirements of coordination, without additional expense.

6. Coordination Drawings drawn to a scale of not less than 1/4-inch to one foot shall be submitted for above ceiling installation of Ductwork, cable trays, communication systems, sprinklers, pipes, valves, lighting fixtures and specialties showing coordination of work between the different trades and with the structural and architectural elements of work. Drawings shall be in sufficient detail to show overall dimensions of related items, clearances, and relative locations of work in allotted spaces. Drawings shall indicate where conflicts or clearance problems exist between various trades prior to the furnishing and installation of the work on site.

1.12 POSTED OPERATING INSTRUCTIONS

A. Furnish approved operating instructions for systems and equipment indicated in the technical sections for use by operation personnel. The operating instructions shall include wiring diagrams, control diagrams and control sequence for each principal system and equipment. Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. Attach or post operating instructions adjacent to each principal system and equipment including start-up, operating, shutdown, safety precautions and procedure in the event of equipment failure. Provide weather-resistant materials or weatherproof enclosures for operating instructions exposed to the weather. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal.

1.13 MANUFACTURER'S RECOMMENDATIONS

A. Where installation procedures or any part thereof are required to be in accordance with manufacturers' recommendations, furnish printed copies of the recommendations prior to installation. Installation of the item shall not proceed until recommendations are received. Failure to furnish recommendations shall be cause for rejection of the equipment or material.

PART 2 - PRODUCTS

2.1 MANUFACTURER (Not Used)

2.2 DIVISION 16 SECTIONS

A. Conform to the requirements of Division 16 sections for all products furnished under this Contract.

2.3 UNDERGROUND LINE MARKERS

A. General: Provide underground line marker tape of the multi-ply type with solid aluminum foil core between two layers of laminated plastic.

1. Provide tape not less than six inches wide and four mils (150 mm) wide and 0.1 mm thick.

2. Provide continuous printing with the words "Buried Electrical Utility Lines," as appropriate for utility services.

PART 3 - EXECUTION

3.1 OUTSIDE SERVICES

A. Connection Points: Underground and overhead electrical services shall be provided to utility and service line connection points.

B. Contract Limits: Where "limits of contract" designations are indicated on site plans, they shall not apply to electric service underground or overhead work necessary to serve the project and occurring outside of the "limits of contract" designations.

3.2 PAINTING AND FINISHING

A. Division 9: Refer to Section 09900, "Painting" for field painting requirements.

B. Damage and Touch-Up: Repair all marred or damaged factory painted finishes with materials and procedures to match original factory finish.

C. Identification: Provide schedules for stencilling and identification markings. Submit stencilling and identification markings for approval.

3.3 CERTIFICATION

A. General: Provide Certification that the installation meets NFPA 70 and manufacturer's recommendations as indicated in the respective sections.

3.4 CUTTING AND PATCHING

A. Cutting: Provide cutting, channeling, chasing and drilling of floors, walls, partitions, ceilings and other surfaces necessary for installation of electrical work. All cutting shall be performed by skilled mechanics of the trades involved.
B. Patching: Repair cut surfaces to match adjacent surfaces.

3.5 CLOSING OF OPENINGS

A. Firestopping: Unused slots, sleeves and other penetrations in floors, walls or other general construction shall be closed and sealed with an approved firestopping material.
   1. Firestopping material shall be UL listed and tested silicone elastomer specifically formulated for use in horizontal and vertical applications. The material shall possess intumescent characteristics and upon exposure to heat above 250 degrees F. (120□C) shall expand to not less than five times its original volume to form a fireproof envelope, UL rated for 2- and 3-hour protection, when applied in accordance with the manufacturer's recommendation.

   2. Floor slots and openings shall be closed with 16 gauge (1.5 mm) galvanized steel sheet supported on 1-inch by 1-inch by 1/8-inch (25 x 25 x 3 mm) structural angle drilled or supported with ponder-driven studs into the building structure. Firestop with a layer of silicone elastomer not less than 1-inch (25 mm) thick which completely fills the opening. The top surface of the silicone elastomer shall be approximately 1-inch (25 mm) below the finished floor slab.

   3. Openings in walls shall be closed with 16 gauge (1.6 mm) galvanized steel sheet securely attached at the midpoint of the wall thickness and firestopped on both sides of the steel sheet with not less than 1/2-inch (13 mm) thick layer of non-sagging silicone elastomer to fully cover the opening.

   4. Single or multiple pipes passing through walls and floors shall have the annulus space between pipes or between pipes and structure filled with silicone elastomer to provide a 3-hour rated firestop for floors and walls.

B. Conduit: The annulus between exposed conduit and walls or floors in finished spaces shall be filled, sealed, and painted to match adjacent surfaces.

C. Future Slots: Identify unused sleeves and slots for future use by permanently anchored brass nameplates identifying size and purpose of the covered slot.

END OF SECTION 16010

SECTION 16110 – RACEWAYS

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Extent of raceway work is indicated on the drawings, by the requirements of this Section, and Section 16010, "Electrical Basic Requirements."

B. Types: Types of raceways in this Section include the following:

1. Electrical metallic tubing.
2. Flexible steel conduit.
3. Steel conduit.
4. Liquid-tight flexible metal conduit.
5. Rigid metal conduit.
6. Wireway.

C. Related Sections: Refer to other sections of Division 16 for the following:

1. Cable Tray Support Devices

1.2 QUALITY ASSURANCE

A. National Fire Protection Association (NFPA): Comply with NFPA 70, "National Electrical Code," for application, size, location and installation of each type of raceway used.

B. Metal Conduit and Tubing: Provide conduit and tubing in conformance with the following standards:

1. Rigid steel conduit zinc coated shall conform to American National Standards Institute (ANSI) C80.2, "Rigid and Steel Conduit."

2. Electrical metallic tubing (EMT), zinc coated shall conform to American National Standards Institute (ANSI) C80.3, "Electrical Metallic Tubing - Zinc Coated."

3. Flexible metal electrical conduit shall conform to UL 1, "Flexible Metal Conduit."

4. Liquid-tight flexible steel conduit shall conform to UL 360, "Liquid-Tight Flexible

C. Wireways, Auxiliary Gutters and Associated Fittings: Provide in conformance with ANSI 870, "Wireways, Auxiliary Gutters, and Associated Fittings."

D. Metal and Plastic Conduit and Raceway Fittings:

1. Fittings for conduit and outlet boxes shall conform to UL 514B, "Fittings for Conduit and Outlet Boxes."

1.3 SUBMITTALS

A. Division 1: Conform to the requirements of Division 1, Section 01003, "Submittals."

B. Product Data: Submit manufacturer's data for items listed, including specifications, installation instructions and general recommendations.

1. Wireway.
2. Raceway Seals.

C. Shop Drawings: Submit dimensioned drawings of raceway and wireway systems showing layout of raceways at all congested areas such as above and below switchboards, motor control centers, and distribution panelboards.

D. Samples: Submit 6-inch(150mm) length of exposed type surface raceways with required finish.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (Not Used)

2.2 CONDUITS, RACEWAYS AND FITTINGS

A. Minimum Size: Size conduit and raceway in accordance with NFPA 70 unless otherwise specified or shown on the drawings.

B. Telephone Conduits: Provide not less than 1-inch (25 mm) trade size.

C. Equipment Ground Conductor (Green): Where specified, shown or required, raceway sizes shall be adequate to include the circuit conductors, an equipment ground conductor and a neutral conductor in accordance with percentage of fill requirements by NFPA 70. Size all conduits supplying motors and associated control equipment to include grounding conductor sized per NFPA 70 whether or not shown on the drawings or specified.

D. Spare Conduits: Where panelboard cabinets are recessed, provide a minimum of three 3/4-inch (20 mm) conduits, plus adequate conduits with sufficient capacity to carry the maximum number and size of future conductors for all spare branch circuit protective devices and spaces in the panelboard. Stub conduit up concealed to a junction box for future connections and extensions located as follows:

1. In an area with removable ceiling, the junction box shall be accessible above the suspended ceiling.

2. In an area with nonremovable ceiling, the junction box shall be recessed in the ceiling directly over the panelboard location.

3. In an area without suspended ceiling but with finished walls, the junction box

shall be recessed in the wall directly above the panelboard location.

4. In an area without suspended ceiling and with unfinished walls, the junction box shall be exposed directly above the panelboard location.

5. All junction boxes shall be in accordance with NFPA 70 as to conductor capacity for the future conductors with adequate knockout on all four sides and a blank screw fastened cover. Provide a pull-wire in all empty conduits.

E. Rigid Steel Conduit and Intermediate Metal Conduit (IMC):

1. Use where exposed conduit is allowed if within 8 feet (2500 mm) of finished floor and wherever susceptible to physical damage.

2. Use for burial in concrete except as otherwise indicated. Field coat with asphalt before installation.

3. Use for direct burial or in slabs in direct contact with earth. Field coat with asphalt before installation.

4. Do not use for corrosive environments.

F. Electrical Metallic Tubing (EMT):

1. Do not bury in ground or in slabs on grade.

2. Do not use in concrete where vibrators are to be used in its placement.

3. Do not use for circuits operating over 600-volts.

G. Flexible Metal Electrical Conduit (Greenfield):

1. Use in dry location.

2. Do not use in corrosive atmosphere or exterior locations.

3. Use to connect motors, transformers and recessed ceiling fixture, wherever equipment must be isolated or shifted to its final position.

4. Use where conduit must be fished in building voids.

H. Liquid-Tight Flexible Steel Conduit:

1. Use for exterior locations.

2. Sizes 1-1/4-inch (Sizes 32 mm) and smaller, provide with a continuous copper bonding conductor wound spirally between convolutions.

3. Sizes 1-1/2-inch (Sizes 40 mm) and larger, provide with an internal grounding conductor and grounding bushings.

I. Wireways, Auxiliary Gutters:

1. May be used to facilitate installation and future changes in wiring between panelboards, safety switches in close proximity to each other on same or adjacent walls or in same electrical equipment room or area.

2. Provide weatherproof enclosure where outdoors or subject to moisture and similar elements.

3. Use where shown on drawings or specified.

4. Shall be completely accessible.

J. Raceway Fittings, Couplings and Connectors:

1. Use fittings listed and approved for specific conduit or raceway system used.

2. For threaded rigid steel conduit do not use threadless or compression type fittings.

3. For EMT, provide steel or malleable iron "concrete-tight" or "rain-tight" couplings and connectors, compression, set screw or stainless steel multiple locking type. Do not use indentation type of fitting.

4. Bushing and connectors shall be insulated type which maintain continuity of conduit grounding system. Insulating material shall be molded or locked into metallic body of the fitting. Bushing made entirely of nonmetallic material will not be allowed.

5. Set screw connectors and couplings body shall have wall thickness at least equal to wall thickness of conduit used. Couplings or conduit trade size 1/2 (15 mm) through 2-inch (50 mm) shall have two set screws per fitting and 2-1/2 through 4-inch (65 mm through 100 mm) shall have four set screws per fitting. Set screws shall be case hardened steel with hex head and cup point.

6. Provide flexible metal conduit fittings made of steel or malleable iron. They shall be insulated and one of the following types:

   a. Wedge and screw type having an angular wedge fitting between the convolutions of the conduit.

   b. Squeeze or clamp type having a bearing surface contoured to wrap around the conduit and clamped by one or more screws.

   c. Steel, multiple point type, for threading into internal wall of the conduit convolutions.

7. Liquid-tight flexible metal conduit shall incorporate a threaded grounding cone, a steel, nylon or equal plastic compression ring and a gland for tightening. Fitting shall be steel, or malleable iron with insulated throat, with male thread and

locknut or male bushing with or without "O" ring seal.

8. Provide expansion fittings for all rigidly fastened conduits spanning a building expansion joint and if not otherwise provided, for all runs 1-1/2-inch (40 mm) or larger, exceeding 150 feet (45 m) in length. Fittings shall be hot-dipped galvanized malleable iron with a packing ring to prevent entrance of water, a pressure ring, a grounding ring and a separate external copper bonding jumper.

9. Inferior material such as "pot metal" shall not be used for any type of fitting.

10. All locknuts shall be the bonding type with sharp edges for digging into the metal wall of an enclosure.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL RACEWAYS AND FITTINGS

A. General:

1. Conduit and EMT runs shall be mechanically and electrically continuous from service entrance to all outlets. Each conduit shall enter and be securely connected to a cabinet, junction box, pull box or outlet by means of a locknut on the outside and a bushing on the inside or by means of a liquid-tight, threaded, self-locking, cold-weld type wedge adapter.

2. Conceal conduit and EMT, unless indicated otherwise, within finished walls, ceilings, and floors.

3. Keep conduit at least 6 inches (150 mm) away from parallel runs of steam and hot-water pipes.

4. Level and square raceway runs.

5. Install horizontal raceway runs above water and steam piping.

6. Complete installation of electrical raceways before starting installation of cables/wires within raceways.

7. Provide supports for raceways as specified elsewhere in Division 16.

8. Prevent foreign matter from entering raceways; use temporary closure protection.

9. Protect stub-ups from damage where conduits rise from floor slabs. Arrange so curved portion of bends is not visible above the finished slab, nor below the slab where the slab is a finished ceiling.

10. Make bends and offsets so the inside diameter is not effectively reduced.

11. Unless otherwise indicated keep the legs of a bend in the same plane and the straight legs of offsets parallel.

12. Use raceway fittings that are of types compatible with the associated raceway and suitable for the use and location.

13. Run concealed raceways with a minimum of bends. All bends shall have the longest possible radii.

14. Install exposed raceways parallel and perpendicular to nearby surfaces or exposed structural members, and follow the surface contours.

15. Run exposed, parallel or banked raceways together.

16. Make bends in parallel or banked runs from the same center line so that the bends are parallel. Factory elbows may be used in banked runs where they can be installed parallel.

17. Join and terminate raceways with fittings designed and approved for the purpose of the raceway system and make up tight.

18. Where the installation is such that joints cannot be made tight, use bonding jumpers to provide electrical continuity of the raceway system.

19. Make the setscrews of threadless fittings up tight; do not use pliers. Compression fittings shall be tightened with two wrenches.

20. Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely and install the locknuts so that the dished part is against the box. Use two locknuts where circuit voltage exceeds 250-volts, one inside and the other outside the box, and where necessary to make the termination secure.

21. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder.

22. Where chase nipples are used, align the raceway and coupling square to the box and tighten the chase nipple so no threads are exposed. Running threads are not allowed.

23. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or plastic having not less than 200 pounds (90 kg) tensile strength. Leave not less than 12 inches (300 mm) of slack at each end of the pull wire.

24. Install telephone and signal system raceways in accordance with the above requirements for raceway and with the additional requirement that no length of run shall exceed 150 feet (45 m) for trade sizes 2 inches (50 mm) and smaller and shall not contain more than two 90-degree ("90-degree)" bends or the equivalent. Provide pull or junction boxes where necessary to complete with these requirements. Make inside radii of bends in conduits one-inch (25 mm) trade size and larger not less than two times the nominal diameter. Terminate conduit in outlet box or with an isolating bushing at locations indicated.

25. Horizontal cross runs of conduit or EMT may be installed in partitions only

where explicitly permitted. Exposed horizontal runs, where permitted, shall be installed close to ceiling or ceiling beams.

26. Conduits and EMT connected to wall outlets shall be run in such a manner that they will not cross water, steam or waste pipes or radiator branches.

27. Conduits and EMT shall not be run through beams, except where clearly indicated on drawings or where permitted.

28. Branch circuit conduits and raceways above suspended ceilings may be supported from the floor construction above or from the main ceiling support members, however, the finished installation shall not interfere with the removability of ceiling panels.

29. Only one 277-volt circuit shall be installed in a wall switch outlet box. Where more than one 277-volt circuit (on different phases) is indicated on drawings as being run to multi-wall-switch units from a ceiling branch circuit outlet box, individual conduit with phase and lighting fixture control wiring and separate outlet boxes with separated wall plates shall be provided to segregate each phase.

B. Raceways in Concrete: Use threaded rigid steel conduit unless other raceway systems are approved.

1. In slabs and walls, locate raceways in middle third and leave at least 1 inch (25 mm) concrete cover. The outside raceway diameter shall not exceed 1/3 of the slab or wall thickness. Lateral spacing of raceways shall be not less than three diameters except where drawings definitely indicate that the concrete slab has been especially designed to accommodate a closer spacing of conduits entering wire closets, panelboards, or electrical boxes or the arrangement is approved.

2. Tie raceway to reinforcing rods or support to prevent sagging or disturbing when concrete is placed.

3. At building expansion joints, provide expansion fittings and cross at right angles to joint.

4. Provide conduits stubbed up through or from concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs, set flush with the finished floor. Extend conductors to equipment in rigid steel conduit, except that flexible metal conduit may be used 6 inches (150 mm) above the floor. Where no equipment connections are made, install screwdriver-operated threaded flush brass plugs in conduit end.

C. Flexible Conduit, Metallic and Non-Metallic: Provide flexible conduits for connections to motors and other electrical equipment when it is subject to movement, vibration, misalignment, cramped quarters or where noise transmission is to be eliminated or reduced. Do not use liquid-tight, flexible non-metallic conduit at locations where ambient temperature may be 25 degrees F.(-4EC) or lower at any time. Install all bonding and grounding conductors for liquid-tight, flexible non-metallic conduit runs within the conduit. Flexible conduit shall be of the liquid-tight type when installed under any of the following conditions:

1. Exterior locations.

2. Moisture or humidity laden atmospheres where it is possible for condensation to accumulate. Corrosive atmospheres.

3. Where water or spray due to wash-operations is frequent or possible. Wherever there is a possibility of seepage or dripping of oil, grease or water.

4. Recessed fluorescent fixtures in the general office areas shall be installed with flexible metallic conduit of not less than 4 feet(200 mm) nor more than 6 feet (1800 mm) in length to permit relocation flexibility. The flexible conduit shall connect the fixture to an accessible junction box above the suspended ceiling.

D. Raceway Sealing Fittings:

1. Sealing fittings for use with threaded steel conduits shall be of the threaded, zinc or cadmium coated, cast or malleable iron type and sealing fittings for use on aluminum conduit shall be of the threaded cast aluminum type. Fittings used to prevent passage of water vapor shall be of the continuous drain type.

2. In concealed work, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces.

3. Provide raceway sealing fittings at the following points, and elsewhere as indicated:

a. Where conduits enter or leave hazardous areas equipped with explosion-proof lighting fixtures, switches, or receptacles. Where conduits pass from warm locations to cold locations, such as refrigerated spaces and air-conditioned spaces. Where conduit enters building from below grade. Additionally, provide a brass or stainless steel conduit drain between seal and exterior wall where seal is below grade. Where required by the NFPA 70.

3.2 ADJUSTING AND CLEANING

A. Upon completion of installation of raceways, inspect interiors of raceways at all outlet, junction and pull boxes, remove burrs and obstructions.

B. Run a swab or mandrel to remove dirt and blockages. Raceways which are deformed and prevent the passage of a mandrel shall be replaced.

C. Remove dirt and construction debris from outlet, junction and pull boxes.

END OF SECTION 16110

SECTION 16120 - WIRE AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Extent of electrical wire and cable work is indicated by drawings and schedules, by the requirements of this Section, and Section 16010, "Electrical Basic Requirements."

B. Types: Types of electrical wire, cable, and connectors specified in this Section include the following:

1. Copper conductors.
2. Tap type connectors.
3. Split-bolt connectors.
4. Wire nut connectors.

C. Other Divisions: Refer to Division 15 sections for the following:

1. Control Wiring

D. Related Sections: Refer to other Division 16 sections for the following:

1. Communications Wire and Cable
2. High Voltage Cable
3. Primary Grounding Supporting Devices

1.2 QUALITY ASSURANCE

A. American Society for Testing and Materials (ASTM): Comply with requirements of the following:

1. B 1 Standard Specification for Hard-Drawn Copper Wire

2. B 2 Standard Specification for Medium-Hard-Drawn Copper Wire

3. B 3 Standard Specification for Soft or Annealed Copper Wire

4. B 8 Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

5. D 753 Standard Specification for General Purpose Polychloroprene Jacket for Wire and Cable.

B. Electrical Testing Laboratories (ETL): Provide wiring, cabling and connector products which are ETL listed and labeled.

C. Institute of Electrical and Electronics Engineers (IEEE): Comply with the following standards which apply to wiring systems:

1. 82 Test Procedure for Impulse Voltage Tests on Insulated Conductors

2. 241 Recommended Practice for Electric Power Systems in Commercial Buildings

D. NFPA: Comply with NFPA 70 requirements for construction, installation and color coding of electrical wire, cable and connections.

E. National Electrical Manufacturers Association (NEMA): Comply with requirements of the following:

1. WC 3 Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

2. WC 5 Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

3. WC 7 Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

4. WC 8 Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

F. UL: Provide material conforming to the following standards:

1. 44 Rubber-Insulated Wires and Cables

2. 83 Thermoplastic-Insulated Wires and Cables

3. 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors

4. 854 Service-Entrance Cables

G. UL Labels: Provide wiring, cabling and connector products which are UL listed and labeled.

1.3 SUBMITTALS

A. Division 1: Conform to the requirements of Division 1, Section 01003, "Submittals."

B. Product Data: Submit manufacturer's data on electrical wire, cables, conductors, connectors and connector crimping tools where specified.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver wire and cable packaged in factory-sealed containers, or wound on NEMA wire and cable reels.

B. Storage: Store wire and cable in a clean dry space in original containers. Protect products from weather, damaging fumes, construction debris and traffic.

C. Handling: Handle wire and cable carefully to avoid abrading, puncturing and tearing

wire and cable insulation and sheathing. Ensure that dielectric resistance integrity of wires/cables is maintained.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (Not Used)

2.2 COPPER WIRE

A. General: Provide wire rated 600 V minimum of the single conductor annealed copper type.

1. Conductors No. 10 AWG and smaller shall be solid, and No. 8 AWG and larger shall be stranded.

2. Conductivity shall not be less than 98 percent at (20 degrees C) 68 degrees F or resistivity greater than 1.7 microhms per centimeter.(17 FΩ/mm (microhms per millimeter).

3. For branch circuit wiring use a minimum wire size of No. 12.

B. Insulation: Provide the following types of insulation:

1. For dry locations provide Type USE/RHH/RHW, THHN/THWN, or XHHW.

2. For dry and wet locations provide Type USE/RHH/RHW, THW, THHN/THWN, or MI.

3. For switchboards provide Type TBS.

2.3 CONNECTORS AND SPLICES

A. General: Provide UL listed metal connectors of sizes, ampacity, temperature ratings, materials, and classes required by NFPA 70 and NEMA standards for applications and services indicated.

B. Branch Circuits: For wires No. 10 AWG and smaller, provide solderless, insulated pressure cable type connectors, 600 V, of the compression or indent type or wire nut connectors. Temperature rating of connectors shall be at least equal to that of the wire on which they are used.

C. Copper Conductors: For No. 8 AWG and larger wire, provide socket head cap, hex screw, or bolt clamp type connectors, manufactured of high conductivity copper alloy or bronze castings. Select proper connector for each wire size. Cable sizes 250 MCM and larger shall be retained in the connector by twin clamping elements.

2.4 INSULATING TAPE, PUTTY, RESIN AND SUPPORTS

A. Tape: Provide plastic electrical insulating tape which is flame retardant, cold and

weather resistant. Tape for use in areas subject to temperatures 30 degrees C. to 105 degrees C., (30EC to 105EC), or where the tape will be subjected to an oil splash, tape shall have a minimum thickness of 8.5 mils,(0.2 mm), and shall consist of an oil-resistant vinyl backing with an oil-resistant acrylic adhesive.

B. Materials: Provide all insulating materials for splices and connections such as glass and synthetic tapes, putties, resins, splice cases, or compositions of the type approved for the particular use, location, voltage and temperature, and apply and install in an approved manner, all in accordance with the manufacturer's recommendations.

C. Supports: Provide cable supports of the wedge type which firmly clamp each individual cable and tighten due to the cable weight.

2.5 PROHIBITED PRODUCTS

A. Cables: The use of non-metallic sheathed cable Types NM to NMC, armored-bushed cable (BX) and armor-clad cable (AC) is prohibited.

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRES AND CABLES

A. General: Install electrical wires, cables and wiring connectors in compliance with applicable requirements of NFPA 70, NEMA, UL and National Electrical Contractors Association (NECA) "Standard of Installation."

B. Conduit: Unless otherwise noted, install all wiring in rigid metal conduit, electric metallic tubing and flexible metal conduit, as indicated on the drawings, in conformance with NFPA 70.

C. Complete System: Provide wire, cables and connectors necessary for a complete installation from point of service connection to all receptacles, lighting fixtures, devices, utilization equipment and outlets for future extensions as indicated on the drawings, in schedules, and in the specification. Provide ample slack wire for connections.

D. Voltage Rating: Wire and cables for general wiring shall be rated for 600 volts minimum. Where the operating voltage is less than 100 V, wire and cables may be insulated for 300 V, provided they are completely isolated from other higher voltage systems.

E. Minimum Size: Minimum branch circuit conductor size shall be No. 12 AWG. Where the length of a branch circuit homerun exceeds 75 feet (25 m) for a 120 V circuit, or 150 feet (45 m) for 277 V, the conductor size shall be No. 10 AWG.

F. Shelf Life: Wire and cable manufactured more than 12 months prior to date of delivery to the site shall not be used.

G. Bundling: Neatly and securely bundle all conductors No. 10 AWG and smaller located in branch circuit panelboards, signal cabinets, signal control boards, switchboards and motor control centers. Neatly and securely cable in individual circuits all conductors larger than No. 10 located in switchboards, motor control centers and pull boxes. Bundle and cable with either marlin twine 2- or 3-ply lacing or nylon straps made of

self-extinguishing nylon having a temperature range of -65 degrees F. to +350 degrees F. (-50EC to 175EC). Each strap shall be constructed with a locking hub or head on one end and a taper on the other.

H. Feeder Identification: Securely fasten nonferrous identifying tags or pressure sensitive labels to all cables, feeders, and power circuits in vaults, pull boxes, manholes, switchboard rooms and at termination of cables.

1. Tags or labels shall be stamped or printed to correspond with markings on drawings or marked so that feeder or cable may be readily identified.

2. If suspended type tags are provided, they shall be attached by approximately 55-pound (245 N) test monofilament line or slip free plastic cable lacing units.

3.2 WIRE PULLING AND CABLE INSTALLATION

A. Raceways: Refer to Section 16110, "Raceways," for the preparation of raceways for wire and cables.

B. Equipment: Provide suitable installation equipment to prevent cutting and abrasion of conduits during the pulling of wires and cables.

1. Ropes used for pulling of conductors shall be made of polyethylene or other suitable nonmetallic material.

2. Metallic ropes shall not be used.

3. Pull conductors simultaneously where more than one is being installed in same raceway.

4. Use pulling compound or lubricant where necessary; compound shall not deteriorate conductor or insulation.

5. Lubricants shall conform to UL requirements applicable.

6. Pulling lines shall be attached to conductor cables by means of either woven basket grips or pulling eyes attached directly to the conductors. Rope hitches shall not be used.

7. All cables installed in a single conduit shall be pulled in together.

8. Where polyethylene insulation is used and a pulling lubricant is required, the lubricant shall be certified by the manufacturer to be non-injurious to such insulation.

C. Supports: Install cable supports for all vertical feeders in accordance with the applicable sections of the NFPA 70.

1. Install exposed cable parallel and perpendicular to surfaces or exposed structural members and follow surface contours, where applicable.

D. Mineral Insulated Cable: Fasten mineral insulated metal sheathed (Type MI) cable

within 12 inches (300 mm) of each turn or offset and at intervals of not more than 6 feet. (1 800 mm. Make cable terminations in accordance with NFPA 70 and the cable manufacturer's recommendations.

E. Splices: Keep conductor splices to a minimum. Splice wires and cables only in outlet boxes, junction boxes, pullboxes, manholes and handholes.

1. In the making of a splice, connectors shall be brought up securely upon the conductors such that all conductors are equally engaged, the insulation is not ruptured, no bare wires are exposed or have "backed off" due to the application of pressure and the connection will not loosen due to cycling or vibration, in order the insure an efficient splice.

2. The number, size and combinations of conductors permitted as listed on manufacturer's packaging of connector shall be strictly followed.

3. Connectors shall be fully insulated by a skirt, or taped to provide an insulation value at least equal to rating of wires being connected.

F. Connectors: Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values or comply with tightening torques specified in UL 486A and 486B.

G. Color Coding: Color code all secondary service, feeder and branch circuit conductors throughout the project secondary electrical system as follows:

208y/120 Volts	Phase	480y/277 Volts
Black	A	Yellow
Red	B	Brown
Blue	C	Orange
White	Neutral	White
Green	Ground	Green

1. The colors shall be factory-applied entire length of the conductors by one of the following methods except as noted and limited below:

   a. Solid color compound.

   b. Solid color coating.

   c. Surface printing every 12 inches (300 mm) maximum spacing of 18 inches (450 mm).

2. All branch circuit conductors Nos. 12 AWG and 10 AWG shall be solid color compound or solid color coating.

3. All sizes of conductors used for neutrals and equipment grounds shall be solid compound or solid color coating white and green, respectively.

4. All phase conductors No. 8 AWG and larger color coded with pressure sensitive tape shall have a background color other than white or green.

5. Field applied color coding methods may be used in lieu of factory coded wire in sizes larger than No. 10 AWG.

6. Color pressure-sensitive plastic tape shall be applied in half overlapping turns for a distance of six inches (150 mm) or all terminal points and in all boxes in which splices or taps are made. The last two laps of tape shall be applied with no tension to prevent possible unwinding.

   1. Tape shall be 3/4-inch (19 mm) wide and colors shall be as specified.

7. Cable identification markings shall not be obliterated by taping and tape locations may be adjusted slightly to prevent obliteration of cable marking.

H. Cable Seals: All wires and cables entering building from underground shall be sealed between cable and conduit or sleeve where cable exits conduit, with a water and gas proof non-hardening sealing compound. See Section 16110, "Raceways," for additional information on seals.

3.3 FIELD QUALITY CONTROL

A. Tests: Feeders and branch circuit insulation shall be tested after installation, and before connection to fixtures and appliances.

1. Tests shall be performed with a 500-volt megger, and conductors shall test free from short-circuits and grounds.

2. Conductors shall be tested phase-to-phase and phase-to-ground.

3. Furnish the instruments, materials, and labor required. Perform the tests in the presence of the Contracting Officer.

4. Test readings shall be recorded and delivered.

B. Demonstration: Subsequent to wire and cable hookups, energize circuit and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

END OF SECTION 16120

SECTION 16130 - ELECTRICAL BOXES AND FITTINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: This Section covers electrical box and electrical fitting work for power, lighting, signal, communication, protection and auxiliary systems.

B. Types: Types of electrical boxes and fittings in this Section include the following:

1. Outlet boxes
2. Junction boxes
3. Pull boxes
4. Conduit bodies
5. Bushings
6. Locknuts
7. Knockout closures

C. Related Sections: Refer to other Division 16 sections for the following:

1. Cabinets and Enclosures

1.2 QUALITY ASSURANCE

A. National Electrical Manufacturers Association (NEMA): Conform to NEMA OS 1 "Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports," for sheet-steel outlet boxes, devices boxes, covers and box supports. Conform to NEMA FB 1, "Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies," for fittings, cast metal boxes and conduit bodies.

B. National Fire Protection Association (NFPA): Comply with NFPA 70, "National Electrical Code," for construction and installation of electrical wiring boxes and fittings.

C. Underwriters Laboratories, Inc. (UL): Provide electrical boxes and fittings which are UL-listed and labeled, and conform to UL 50, "Cabinets and Boxes," UL 514A, "Metallic Outlet Boxes," UL 514B, "Fittings for Conduit and Outlet Boxes."

1.3 SUBMITTALS

A. Division 1: Refer to Section 01003, "Submittals," for basic information relating to submittal requirements.

B. Product Data: Submit manufacturer's data on electrical boxes and fittings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (Not Used)

2.2 GENERAL

A. Product Selection: Select boxes of types appropriate for each use and location.

1. Select covers for boxes of types appropriate for each use and location.

2. Provide gaskets for covers of boxes in damp locations.

B. Corrosion resistance: Provide galvanized or other approved corrosion resistant finish for all boxes, accessories and fittings.

2.3 FABRICATED MATERIALS

A. Interior Outlet Boxes: Provide minimum 4-inch (100 mm) square by 1-1/2-inch (38 mm) deep, one piece, deep-drawn, galvanized steel, outlet boxes for general use. Provide 4-inch (100 mm) octagonal concrete boxes and hung ceiling boxes of the folded or welded type where required by project conditions. Provide square cornered, straight sided gang boxes wherever required by NFPA 70 or more than two wiring devices are indicated in the same location. Provide boxes of increased depth where required by the project.

1. Construct with stamped knockouts in the back and sides.

2. Provide threaded screw holes with corrosion-resistant screws for securing box covers and wiring devices.

B. Interior Outlet Box Accessories: Provide outlet box accessories as required for each installation, including plaster covers, mounting brackets, wallboard hangers, extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, which are compatible with outlet boxes being used and fulfilling requirements of individual wiring situations.

C. Junction and Pull Boxes: Provide galvanized sheet steel junction and pull boxes, with screw-on covers and of types, shapes and sizes, to suit each respective location and installation.

1. Provide welded seams and stainless steel nuts, bolts, screws and washers.

2. Conform to the applicable requirements of NFPA 70 and to UL 50 for boxes over 100 cubic inches (1 600 cm^2) volume, except as modified below.

3. Where necessary for boxes to provide a rigid assembly, provide integral structural steel bracing.

D. Conduit Bodies: Provide galvanized cast-metal conduit bodies, of types, shapes and sizes, to suit respective locations and installation, construct with threaded-conduit-entrance ends, removable covers, and corrosion-resistant screws.

E. Bushings, Knockout Closures and Locknuts: Provide corrosion-resistant punched-steel box knockout closures, conduit locknuts, malleable iron conduit bushings and offset connectors of types and sizes to suit respective uses and installation.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS, GENERAL

A. Coordination: Coordinate installation of electrical boxes and fittings with wire/cable and raceway installation work, and with general construction work.

B. Weatherproof: Provide weatherproof outlets for all interior and exterior locations exposed to weather or moisture.

C. Knockout Caps: Provide knockout closures to cap unused knockout holes where blanks have been removed.

D. Anchoring: Support and fasten boxes securely.

E. Sizes: Provide boxes of sizes adequate to meet NFPA 70 volume requirements, but in no case smaller than sizes indicated.

3.2 INSTALLATION OF OUTLET BOXES

A. Grounding: Provide each box to which a lighting fixture or receptacle is to be attached with a grounding terminal, consisting of either a green-colored washer-in-head machine screw, not smaller than No. 10-32, screwed into a tapped hole or a grounding bushing attached to one of the conduits.

B. Mounting Height: The "mounting height" of a wall-mounted outlet box is defined as the height from the finished floor to the horizontal center line of the cover plate.

1. Where mounting heights are not indicated or where heights and locations interfere with mechanical, architectural or structural features, install outlet boxes in an approved location, without additional cost .

2. Where a ceiling outlet and a dropped beam or other change in ceiling level are shown at the same location, place the outlet at least 230 mm from the finished edge of the beam or change in level, except as otherwise indicated.

C. Prohibited Work:

1. Do not use sectional (gangable) boxes.

2. Do not use device plates as covers for boxes in exposed locations.

3. Do not use round boxes where conduit must enter box through side of box, which would result in difficult and insecure connections when fastened with locknut or bushing on rounded surface.

D. Protection: Protect outlet boxes to prevent entrance of plaster, and debris. Thoroughly clean foreign material from boxes before conductors are installed.

E. Threaded Hubs: At the following locations use threaded hub type boxes with gasketed weatherproof covers:

1. Where installed on unfinished walls, columns or plasters. Cover gaskets may be omitted in dry locations.

2. Where exposed to moisture laden atmosphere.

3. Where indicated.

F. Deep Boxes: Use extra deep concrete boxes maximum 150 mm, where necessary to permit side conduit entrance without interfering with reinforcing.

G. Extension Rings: Where extension rings are required on existing outlet boxes, drill new mounting holes in the rings to align with the mounting holes on the existing boxes.

3.3 PULL AND JUNCTION BOXES

A. Installation: For installation of junction and pull boxes, conform to NFPA 70 and the following:

1. For boxes exposed to rain or installed in wet locations use weatherproof type.

2. For boxes in main feeder conduit runs use sizes not smaller than 8 inches square by 4 inches (200 mm square by 100 mm) deep.

3. Do not exceed 6 conductors entering and 6 leaving raceways in a single box.

4. Conductors in any pull or junction box including equipment grounding conductors shall not exceed:

Size of Largest Conductors	Maximum No. of Conductors
No. 4/0 AWG	30
250 MCM	20
500 MCM	15
Over 500 MCM	10

B. Supports: Provide in each box, including boxes above switchboards and motor control centers, with sufficient clamps, grids, or devices to which cables are secured in neat and orderly fashion permitting ready identification and so that no cable will have an unsupported length of more than 30 inches (750 mm).

C. Adjacent Boxes: Locate no box within 2 feet (600 mm) of any other pull or junction box.

D. Flush Mount: Mount pull boxes concealed in nonaccessible walls or ceilings, with the covers flush with the finished wall or ceiling.

END OF SECTION 16130

SECTION 16135 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Extent of wiring device work is indicated on drawings and schedules, by requirements of this Section, and Section 16010, "Electrical Basic Requirements."

B. Types: Types of electrical wiring devices specified in this Section include the following:

1. Receptacles.
2. Ground-fault circuit interrupters.
3. Switches.
4. Photocells.
5. Time switches.
6. Motion detectors.
7. Dimmers.
8. Wallplates.
9. Telephone/power poles.
10. Plugs and connectors.
11. Incandescent lampholders.

C. Related Sections: Refer to other sections of Division 16 for the following:

1. Wire and Cables.
2. Boxes.

D. Other Divisions: Refer to other Divisions of the specifications for the following work:

1. Painting: Division 9.

1.2 QUALITY ASSURANCE

A. Codes: Provide wiring devices conforming to the following:

1. American National Standards Institute (ANSI): Provide plugs and receptacle devices constructed in accordance with ANSI C73, "Attachment Plugs and Receptacles, Dimensions of."

2. Institute of Electrical and Electronics Engineers (IEEE): Construct and install wiring devices in accordance with requirements of IEEE 241, "Recommended Practice for Electric Power Systems in Commercial Buildings."

3. National Electrical Manufacturers Association (NEMA): Provide wiring devices constructed and configured in accordance with the requirements of:

a. WD 1 General Requirements for Wiring Devices.

b. WD 2 Semiconductor Dimmers for Incandescent Lamps.

c. WD 6 Wiring Devices - Dimensional Requirements.

4. National Fire Protection Association (NFPA): Comply with NFPA 70, "National Electrical Code" as applicable to construction and installation of electrical wiring devices.
5. Underwriters Laboratories, Inc. (UL): Provide wiring devices which are UL listed and comply with the requirements of:

a.	20	General-Use Snap Switches.
b.	514A	Metallic Outlet Boxes.
c.	514B	Fittings for Conduit and Outlet Boxes.
d.	943	Ground-Fault Circuit Interrupters.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's data on electrical wiring devices.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Handling: Handle wiring devices carefully to prevent damage. Do not install damaged wiring devices, replace with new.

B. Storage: Store wiring devices in a clean and dry place. Protect from dirt, construction debris, and physical damage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (Not Used)

2.2 WIRING DEVICES

A. General: Provide factory-fabricated wiring devices, in types, colors, and electrical ratings for applications indicated and which comply with NEMA WD 1. Provide ivory color devices and wallplates except as otherwise indicated; submit color selection.

1. For computer services receptacles, provide orange colored receptacles as dedicated computer service circuits having separate grounds.

2. For duplex receptacles on emergency circuit, provide red receptacles with red baked enamel cover plates.

2.3 RECEPTACLES

A. Duplex Receptacles: Provide specification grade duplex receptacles, 2-pole, 3-wire grounding, with green hexagonal equipment ground screw, ground terminals and poles internally connected to mounting yoke, 20 A, 125 V, with metal plaster ears, design for side wiring with four captively held binding screws and provisions for back wiring from eight separate metal wiring clamps, with spring loaded, screw activated pressure plate, with NEMA configuration 5-20R unless otherwise indicated.

B. Single Receptacles: Provide specification grade single receptacles, 2-pole, 3-wire,

grounding, with green hexagonal equipment ground screw, 20 A, 125 V, with metal plaster ears, design for side and back wiring with spring loaded, screw activated pressure plate, with NEMA configuration 5-20R unless otherwise indicated.

C. Ground Fault Interrupter: Provide [termination] [feed-thru] type ground fault circuit interrupters, with duplex receptacles, capable of protecting connected [downstream] receptacles on single circuit, and installed in a 2-3/4 (70 mm) inch deep outlet box without adaptor. Provide grounding type UL rated Class A, Group 1, rated 20 A, 125 V, 60 Hz; solid-state ground fault sensing and signaling with 5 milliamperes ground fault trip level, equip with NEMA configuration 5-20R.

D. Weatherproof Receptacles: Provide duplex receptacles, 20 A, 125 V, NEMA 5-20R in cast metal box with gasketed, weatherproof cast metal cover plate and gasketed cap over each receptacle opening. Provide cap with spring hinged cover flap.

2.4 SWITCHES

A. General: Provide specification grade switches as indicated on the drawings conforming to NEMA WD 1 and to the following.

B. Snap Switches: Provide specification grade, general duty flush single pole toggle AC quiet switches, 20 A, 120-277 V, with mounting yoke insulated from mechanism, equip with plaster ears, switch handle and back or side-wired screw terminals. Provide captive or terminal type terminal screws not smaller than No. 8. Provide back-wired devices with separate access holes for wiring.

C. Three Way Switches: Provide specification grade, general duty flush 3-way AC quiet switches, 20 A, 120-277 V, with mounting yoke insulated from mechanism, equip with plaster ears, lock type switch handles, back or side wired screw terminals, with break-off tab features, which allows wiring with separate or common feed. Provide captive terminal type terminal screws not smaller than No. 8. Provide back wired devices with separate access holes for wiring.

D. Four Way Switches: Provide specification grade, general duty flush 4-way AC quiet switches, 20 A, 120-277 V, with mounting yoke insulated from mechanism, equip with plaster ears, switch handles, back or side wired screw terminals, with break-off tab features, which allows wiring with separate or common feed. Provide captive type terminal screws not smaller than No. 8. Provide back wired devices with separate access holes for wiring.

E. Touch Snap Switches: Provide soft-touch snap switches, capable of effortless fingertip operation; single pole AC quiet, with lighted rocker switch handles; back or side wired screw terminals for connecting copper clad aluminum wire, 20 A, 120-277 V rating. Equip with plaster ears. Provide captive or terminal type terminal screws not smaller than No. 8. Provide back wired devices with separate access holes for wiring.

F. Photocells: Provide quick-response, cadmium-sulfide type photocell with 15 to 20 second built-in time delay to prevent response to momentary lightning flashes, car headlights or cloud movements. Energize photocells when north sky light decreases to 1.5 footcandles (15 lux) and maintain system energized until north sky light increases to 3 to 5 footcandles. (30 to 50 lux). Provide photocells of voltage and wattage ratings as

indicated.

G. Time Switches: Provide automatic electric motor driven time switch(es) that are SPST mounted in a NEMA general purpose enclosure as indicated on the drawings. Provide a mechanism that is readily removable from the enclosure. Provide the time switch with 24-hour astronomical dial with ON-OFF operations per 24-hour period. Arrange the switch to eliminate operations on any day or days. Provide timer motor that is self-starting, heavy duty with lifetime lubrication for operation on 120 V 60-cycle supply. Provide contacts that are heavy duty 30V.

H. Motion Detectors: Provide modular, plug together ultrasonic detectors wired so that the lights within the room shall be controlled to turn on and off automatically by the detectors. Each room indicated on drawings is to be controlled independently]

1. Switching devices and power transformers shall be prepackaged metal power module box which shall include a prewired receptacle into which a sensor box shall be plugged during installation. Power module size shall be selected by load size to be controlled.

2. Provide detectors, power modules, interconnect boxes and all other material and equipment as required make motion detector controls fully operable.

3. Provide a sensitivity or gain control for proper adjustment of the detector range to the area it is to control. Detectors shall operate on 12 VAC and consume no more than one watt of power. Detectors must operate silently.

4. The detectors shall contain a time delay adjustment of from 1 to 30 minutes. Once motion ceases, the adjusted time shall pass before lights are automatically switched off. Lights shall come on immediately after the beam pattern has been broken.

5. The detector itself shall be the only visible portion of the unit. The power transformer and controlled switch contacts shall be concealed. House visible detector in a white, high impact plastic steel enclosure of the manufacturer's standard design.

6. Provide a key operated switch where shown on the drawings to operate the light and manually override the motion detector. Switch shall be similar to that described in paragraph entitled "Snap Switches" of this Section, except that the handle shall be tamperproof, key operated and locking.

2.5 COMBINATION DEVICES

A. General: Provide specification grade, general duty 3-way quiet switch, 20 A, 120-277 VAC, with toggle switch handle, and 3-wire grounding receptacle, 20 A, 120 V, equip with plaster ears, and with break-off tab feature which permits wiring for separate or common feed, NEMA configuration 5-20R.

2.6 INCANDESCENT LAMP DIMMERS

A. General: Provide branch lighting, solid-state, AC dimmer controls for incandescent fixtures; wattage as indicated, 120 V, 60 Hz, with continuously adjustable rotary dimmer, anodized aluminum face, single-pole, with soft-tap ON-OFF switch. Equip with electromagnetic filters to eliminate noise, RF and TV interference, and with 5-inch (125 mm) length wire connecting leads.

2.7 FLUORESCENT LAMP DIMMERS

A. General: Provide single-pole, full-wave semiconductor modular type AC dimmers for fluorescent fixtures; with 60 Hz, wattage and voltage as indicated, and with electromagnetic filters to reduce noise, RF, and TV interference to minimum. Construct with continuously adjustable trim potentiometer for dimming and with anodized heat sinks. Provide 5-inch (125 mm) length wire connecting leads.

2.8 WIRING DEVICE ACCESSORIES

A. Wall plates: Provide wall plate for each switch, receptacle, signal and telephone outlet and special purpose outlet. Do not use sectional gang plates. Provide multi-gang outlet plates for multi-gang boxes. Wall plates shall be in accordance with UL 514A, UL 514B, and UL 514C.

1. Material and Finish: Provide ivory finish, phenol-resin or urea-resin plates of approved design, in unfinished areas, mechanical spaces, fan rooms, wire closets, transformer rooms, storage rooms, and on walls that are painted. Provide stainless steel or chromium finished plates in lobbies, corridors, special finished areas, toilet rooms, or on walls finished with marble, plastics, glazed ceramic interior tile. Provide finishes that are corrosion-resisting steel (18 percent chromium, 8 percent nickel) with satin finish. Match the finish of fastening screws with the plates. Provide plates for exposed screw jointed fittings that match the fittings with edges of plates flush with edges of fittings and made of heavy cadmium plated steel. Provide plates for cast type boxes at locations subject to wet or rain covers for "push" action type flush switches that are neoprene gasketed.

2. Telephone and Signal Outlets: Provide wall plates for telephone and signal outlets with a 3/8-inch (10 mm) bushed opening in the center. Provide wall plates for push-button and buzzer outlets with openings to suit the push-button and buzzers. Provide material, which matches other device plates.

B. Telephone/Power Poles: Provide factory-assembled telephone/power poles of types, sizes and ratings indicated; for use with telephone and power systems installed above

suspended ceilings. Construct with provisions for one telephone cable, cable size 50 pairs, and with two, 20 A, 125 V, 3-wire receptacles. Isolate power section from telephone compartment with separating steel enclosure. Extend wiring from receptacles to junction box at top of pole where connections are made above suspended ceiling. Provide pole foot with carpet pad; also provide pole with ceiling tile trim pad.

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRING DEVICES

A. General: Install wiring devices as indicated, in accordance with manufacturer's written instructions, applicable requirements of NFPA 70 and NEMA "Standard of Installation," and in accordance with recognized industry practices to fulfill project requirements. Where not indicated, mount switch adjacent to latch jamb of door.

B. Coordination: Coordinate with other work, including painting, electrical boxes and wiring work, as necessary to interface installation of wiring devices with other work.

C. Boxes: Install wiring devices only in electrical boxes which are clean; free from excess building materials, dirt, and debris.

D. Receptacles: Install receptacles 12 inches (300 mm) above the finished floor, unless otherwise noted or specified.

E. Work Sequence: Install wiring devices after wiring work is completed.

F. Connectors and Terminals: Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors," UL 486B, "Wire Connectors for Use with Aluminum Conductors." Use properly scaled torque indicating hand tool.

G. Switches: Do not connect switches in the neutral conductor. Install switches indicated by "S" with subletter to control the outlets indicated; however if subletter is omitted, install switches to control the nearest outlet. If there is only one switch indicated in the room, install the switch to control all lighting outlets in the room even though they are not indicated by subletter. Install switches with centerline located 4 feet(1 200 mm) above finished floor unless otherwise indicated by numerals, indicating inches above floor, shown adjacent to letter "S" or by on appropriate note on drawings. Install switches rigidly attached to outlet boxes by means of two screws.

H. Motion Detectors: Mount on ceiling out of normal reach.

3.2 PROTECTION OF WALL PLATES AND RECEPTACLES

A. General: Upon installation of wall plates and receptacles, advise Contracting Officer regarding proper and cautious use of convenience outlets. At time of substantial completion, replace those items which have been damaged, including those burned and

scored by faulty plugs.

3.3 GROUNDING

A. General: Provide equipment grounding connections for wiring devices, unless otherwise indicated. Tighten connections to comply with tightening torques specified in UL 486A to assure permanent and effective grounds.

B. Heavy Duty Plug-In Strip Receptacles: Connect all receptacle grounds with ground conductor effectively and securely attached to the building equipment grounding system. Where more than one circuit serves the common raceway adjacent receptacles shall not be connected to the same circuit.

3.4 TESTING

A. General: Test wiring devices for electrical continuity, and for short-circuits prior to energizing circuitry. Ensure proper polarity of connections is maintained. Subsequent to energization, test wiring devices to demonstrate compliance with requirements.

END OF SECTION 16135

SECTION 16160 - CABINETS AND ENCLOSURES

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: This Section covers cabinets and individual hinged-door enclosures for all electrical and automatic control systems including, but not limited to, power, lighting, control, communications, protection and auxiliary systems. Extent of the work is shown on the drawings, by the requirements of this Section, and Section 16010, "Electrical Basic Requirements."

1.2 QUALITY ASSURANCE

A. National Electrical Manufacturers Association (NEMA): Comply with NEMA 250, "Enclosures for Electrical Equipment 1000 Volts Maximum."

B. National Fire Protection Association (NFPA): Comply with NFPA 70, "National Electrical Code" for application, and installation of electrical cabinets and enclosures.

C. Underwriters Laboratories, Inc. (UL): Provide electrical cabinets and enclosures which are UL listed and labeled, and constructed in conformance with UL 50 "Cabinets and Boxes."

1.3 SUBMITTALS

A. Division 1: Conform to the requirements of Division 1, Section 01003, "Submittals."

B. Product Data: Submit manufacturer's data on electrical cabinets and enclosures.

C. Shop Drawings: Submit dimensioned drawings of electrical cabinets and enclosures.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (Not Used)

2.2 GENERAL

A. Types: Provide cabinets and enclosures of arrangements indicated and specified.

B. Materials: Provide cabinets and enclosures as follows:

1. In normally dry interior locations, provide sheet steel with corrosion resistant fasteners.

2. Outdoors and in damp interior locations, provide galvanized sheet steel with stainless steel fasteners.

3. At constantly wet locations or corrosive atmospheres, provide stainless sheet steel with stainless steel fasteners.

C. Enclosures: Provide the following types and designs:

1. For all electrical power wiring or components in dry interior locations use NEMA 1 enclosure.

2. For all electrical power wiring or components outdoors use NEMA 3R enclosure.

3. For electronics, alarm, control or non-telephone communications type wiring or components indoors use NEMA 12 enclosure.

4. For all electrical components and wiring in constantly wet locations or corrosive atmospheres use NEMA 4X enclosure.

D. Construction: Provide cabinets and enclosures as follows:

1. For flush NEMA 1 Cabinets, provide a front consisting of a one- piece sheet steel frame and a hinged door with catch and lock.

2. Provide a frame 3/4-inch (20 mm) larger than the cabinet on all sides, for recessed enclosures.

3. Arrange door to close against a rabbit placed all around the inside edge of the frame, with a uniformly close fit between door and frame.

4. Provide concealed fasteners, not over 24inches (600 mm) apart, to hold fronts to cabinet boxes.

5. Provide flush or concealed door hinges not over24 inches apart and not over 6 inches (600 mm apart and not over 150 mm) from ends of door.

6. Provide concealed fasteners, including means for security, supporting and adjusting fronts of cabinets.

7. Provide each cabinet with a combination catch and flat key lock.

8. Fit the electrical and auxiliary system cabinet locks to separate keying for each system. Furnish one key for each cabinet or a maximum of 30 keys per system.

9. Locks may be omitted on signal, power and lighting cabinets located within wire closets and transformer-switchboard rooms. If locks are provided at these locations, make them of a type to permit doors to be closed without locking.

10. For cabinets with width greater than 24inches, (600 mm), provide double doors.

E. Surface NEMA 1 Cabinets and Enclosures:

1. Provide construction equivalent to NEMA 1 flush cabinets but with fronts same dimensions as cabinet box.

2. Doors may be hinged directly to cabinet, with 3/4-inch(20mm) flange around all edges shaped to cover edge of box.

F. Surface NEMA 12 Cabinets and Enclosures:

1. Fabricate of minimum 16 MSG (1.6 mm) steel with continuous welded seams.

2. Provide removable doors, with neoprene door gasket attached with oil-resistant adhesive, and held in place with steel retaining strips.

3. Provide removable internal mounting panel for component installation.

4. Provide handle operated, key-locking latches for doors.

5. Provide multiple doors where required. Individual door width shall be no greater than 24 inches (600 mm).

G. Surface NEMA 3R Cabinets:

1. Fabricate of minimum 16 MSG (1.6mm) steel.

2. Use double doors for cabinets more than 24 inches (600 mm) wide.

3. Provide butt hinges or continuous hinges.

4. Furnish single door cabinets with padlock and hasp, and double door cabinets with 3-point handle-operated-latch plus hasp.

5. Provide all stainless steel fasteners.

H. Surface NEMA 4 Cabinets and Enclosures:

1. Provide features similar to those for NEMA 12 units except provide NEMA 4 protection against hose directed water. Provide multiple cover clamps in lieu of handle latches.

2. Provide doors over 48 inches (1200 mm) in height with vault handle and a 3-point catch, arranged to fasten door at top, bottom, and center.

I. Painting: In addition to galvanizing or priming coat, all inside and outside surfaces of trim and doors shall be given a factory finish coat of gray paint. Recessed boxes and surface boxes in transformer vaults, switchgear rooms and electric closets may be galvanized or painted.

J. Grounding: Provide cabinets and enclosures with provision for cabinet grounding without penetrating exterior wall of the enclosure.

PART 3 - EXECUTION

3.1 INSTALLATION OF CABINETS AND ENCLOSURES

A. Flush Cabinets: Set flush cabinets in finished spaces flush with adjacent walls. Mount cabinets with fronts straight and plumb.

B. Painting: Touch up all welds, scrapes and other mars in the enclosure finish with a rust inhibiting paint.

C. Mounting: Mount cabinets at a uniform height, nominally 6 feet 6 inches (2 m) to the top of the enclosure above finished floor, except as otherwise noted.

D. Support: Support and fasten all cabinets securely in place.

END OF SECTION 16160

SECTION 16190 - SUPPORTING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Provide support for all electrical items using supports, anchors, sleeves, seals, fastenings and other components. The extent of supporting devices is covered by this Section, the drawings and Section 16010, "Electrical Basic Requirements."

B. Types: Types of supports, anchors, sleeves, seals and fastenings specified in this Section include the following:

1. Clevis hangers.
2. Riser clamps.
3. C-clamps.
4. I-beam clamps.
5. One-hole conduit straps.
6. Two-hole conduit straps.
7. Round steel rods.
8. Lead expansion anchors.
9. Toggle bolts.
10. Wall and floor seals.

C. Equipment: Supports, sleeves, seals and fasteners furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division 16 sections.

1.2 QUALITY ASSURANCE

A. National Fire Protection Association (NFPA): Comply with NFPA 70 as applicable to construction and installation of electrical supporting devices.

B. Underwriters Laboratories, Inc. (UL): Conform to UL listings and labelling.

1.3 SUBMITTALS

A. Division 1: Conform to requirements of Division 1, Section 01003, "Submittals."

B. Product Data: Submit catalog cuts, specifications, and installation instructions, for each type of support, sleeve and seal. Submit hanger and support schedule showing manufacturer's figure number, size, spacing features and application for each type of hanger, support, sleeve, seal and fastener to be used.

C. Shop Drawings: Submit dimensioned drawings of fabricated products, indicating details of fabrication and materials.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (Not Used)

2.2 PRODUCTS

A. General: Provide supporting devices with manufacturer's standard materials, designed and constructed in accordance with published product information, for a complete installation and as herein specified.

B. Corrosion Resistance: Provide all supports, support hardware and fasteners hot-dipped galvanized or cadmium plated.

C. For Raceway Supports: Provide manufacturer's standard supports including clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze, wall brackets and spring steel clamps.

D. Fasteners: Provide fasteners of types, sizes and materials indicated with the following construction

1. 1/2-inch (13mm)lead expansion anchors approximately 38 pounds weight per 100 units(17.25 Kg weight per 100 units).

2. 3/16-inch by 4-inch (5mm by 100mm) springhead toggle bolts approximately 5 pounds weight per 100 units (2.25 Kg weight per 100 units).

E. Sleeves and Seals: Provide sleeves and seals, of types, sizes and materials indicated with the following features:

1. Provide factory-assembled watertight wall and floor seals, of types and sizes indicated or required suitable for sealing around conduit, pipe, or tubing passing through concrete floors and walls. Construct with steel sleeves, malleable iron body, neoprene sealing grommets and rings, metal pressure rings, pressure clamps, and cap screws.

2. Smoke and fire stop seals shall have a UL fire rating of 3 hours where installed in fire rated construction or as indicated. Seals shall be internal (unflanged) type to occupy minimum space.

F. U-Channel Strut Systems: Provide U-channel strut system for mounting and supporting electrical equipment. Fabricate strut from 16-gauge (1.6 mm) hot-dip galvanized steel sheet, 9/16-inch (14 mm) diameter holes, 8-inches (200 mm) on center on top surface. Fittings shall mate with the U-channel.

G. Lead and Oakum: Caulk between sleeve and pipe where a fire rated seal is not required or specified.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Compliance: Install hangers, sleeves, seals, U-channel supports and fasteners as indicated and in accordance with manufacturer's written instructions. Comply with requirements of NFPA 70 and American National Standards Institute (ANSI)/National Electrical Manufacturers Association (NEMA) for installation of supporting devices.

B. Coordination: Coordinate with other electrical work, including raceway and wiring work.

C. Raceway Supports:

1. Provide raceway support meeting the requirements of these specifications and NFPA 70. Conform to manufacturer's recommendations. For each support provide strength equal to the maximum weight of the present local plus all future raceways for which the support provides space, times a safety factor. Except as otherwise indicated, use a safety factor greater than four where necessary to provide a minimum safety allowance of 200 pounds (90 kg). Provide additional support strength where required to prevent distortion of raceway during wire pulling.

2. Provide individual and multiple (trapeze) raceway hangers, and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly, and for securing hanger rods and conduits.

3. Arrange for grouping of parallel runs of horizontal raceways to be supported together on trapeze type hangers where possible.

4. Support individual horizontal conduits and EMT 1-1/2-inch (40 mm) size and smaller by either one-hole pipe straps or separate pipe hangers, use separate pipe hangers for larger sizes. Spring steel fasteners may be used in lieu of pipe straps or hangers for sizes 1-1/2-inch (40 mm) and smaller in dry locations. For hanger rods with spring steel fasteners, use 1/4-inch (6.5 mm) diameter or larger threaded steel. Use steel fasteners that are specifically designed for supporting single conduits or EMT. Unless otherwise indicated, do not use wire as a means of support. Use spring steel conduit supports only for lighting system branch circuit raceway in suspended ceilings in dry locations.

5. Except as otherwise indicated, space supports for metallic and non-metallic raceways in accordance with the requirements of this Section and the requirements of the NFPA 70.

6. Provide support for exposed or concealed raceway as close as practical to and not exceeding one foot (300 mm) from an unsupported box or access fitting. In horizontal runs a support at a box or access fitting may be omitted when the box or access fitting is independently supported and the raceway termination is not made with a close nipple or threadless box connector.

7. In vertical runs provide such support that the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports, with no weight load on raceway terminations or conductor terminals.

D. Miscellaneous Supports:

1. Provide supports for all miscellaneous electrical components as required to produce the same safety allowances as specified for raceway supports above. Provide metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes etc.

2. In open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support; support sheet metal boxes

directly from the building structure or by bar hangers. Where bar hangers are used, attach the bar to raceways on opposite sides of the box and support the raceway with an approved type fastener not more than 24 inches (600 mm) from the box. When penetrating reinforced-concrete members, avoid cutting any reinforcing steel.

E. Fasteners:

1. Unless otherwise indicated securely fasten all electrical items and their supporting hardware including, but not limited to, conduits, raceways, cables, cable trays, busways, cabinets, panelboards, wall-mounted transformers, boxes, disconnect switches and control components to the building structure.

2. Fasten by means of wood screws or screw-type nails on wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; by machine screws; welded threaded studs, or spring-tension clamps on steel work. Threaded studs driven in by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts or machine or wood screws. Do not weld conduits or pipe straps to steel structures. In partitions of light steel construction use sheet metal screws.

3. Holes cut to a depth of more than 1-1/2 inches (40 mm) in reinforced concrete beams or to a depth of more than 3/4-inch (20 mm) in concrete joints shall not cut the main reinforcing bars. Fill holes that are not used.

4. Loads applied to any fastener shall not exceed one-fifth of the proof test load. Use vibration and shock-resistant fasteners

F. Sleeves and Seals:

1. Tighten sleeve seal nuts until sealing grommets have expanded to form watertight and smoketight seal.

2. Sleeves: Where installed in existing slabs or partitions completely fill the void between the sleeve and masonry with expanding cement grout.

END OF SECTION 16190

SECTION 16195 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Extent of electrical identification work required by this Section is indicated in this Section, on the drawings or where specified in other sections of Division 16.

B. Types: Types of electrical identification work specified in this Section include the following:

1. Identification of electrical power, control and communication raceways, cables and conductors.

2. Operational instruction signs.

3. Warning and caution signs.

4. Equipment labels and signs.

C. Related Sections: Refer to other sections for the following:

1. Electrical Basic Requirements.
2. Product Labels and Nameplates.
3. Wire and Cables.

1.2 QUALITY ASSURANCE

A. American National Standards Institute (ANSI): Comply with requirements of ANSI A13.1, "Scheme for the Identification of Piping Systems" with regard to type and size of lettering for raceway and cable labels.

B. National Fire Protection Association (NFPA): Comply with NFPA 70, "National Electrical Code" requirements for identification and for provision of warning and caution signs for wiring and equipment.

1.3 SUBMITTALS

A. Division 1: Conform to the requirements of Division 1, Section 01003, "Submittals."

B. Product Data: Submit manufacturer's data on electrical identification materials and products.

C. Samples: Submit samples of each color, lettering style and other graphic representation required for identification materials. Submit samples of labels and signs.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (Not Used)

2.2 ELECTRICAL IDENTIFICATION PRODUCTS

A. General: Except as otherwise indicated, provide manufacturer's standard products of categories and types required for each application.

B. Adhesive Marking Labels for Raceway and Metal-Clad Cable: Provide pre-printed, flexible, self-adhesive labels with legend indicating voltage and service (Emergency, Lighting, Power, Light and Power, DC, Air Conditioning, Communications, Control, Fire Alarm.) Size: 1-1/8 inches (28 mm) high by 4 inches (100 mm) long for raceway 1-inch (25 mm0 diameter and less, 1-1/8 inches (28 mm0 high by 8 inches (200 mm) long for raceway over 1-inch (25 mm) diameter. Color: Black legend on orange background.

C. Pre-Tensioned Flexible Wrap-Around Colored Plastic Sleeves for Raceway Identification: Provide flexible acrylic bands sized to suit the raceway diameter and arranged to stay in place by pre-tensioned gripping action when coiled around the raceway or cable. Color: Black legend on orange background.

D. Wire/Cable Designation Tape Markers: Provide vinyl or vinyl cloth, self-adhesive wrap-around cable/conductor markers with pre-printed numbers and letters for designation purposes.

E. Aluminum Wrap-Around Cable Marker Bands: Provide bands cut from 0.014-inch (0.35 mm) thick aluminum sheet and fitted with slots or ears for securing permanently around wire or cable jacket or around groups of conductors. Provide for legend application with stamped letters or numbers.

F. Plasticized Card Stock Tags: Provide vinyl-cloth tags with pre- printed or machine printed legend to suit the application. Provide orange background, except as otherwise indicated and eyelet for fastener.

G. Brass or Aluminum Tags: Provide metal tags with stamped legend, punched for fastener. Dimensions shall be 2 inches by 2 inches by 19-gauge (50 mm by 50 mm by 1 mm) thick.

H. Engraved Plastic-Laminate Labels, Signs and Instruction Plates: Provide engraving stock melamine plastic laminate, 1/16-inch (1.5 mm) minimum thickness for up to 20 square inch sign or 8-inch length; 1/8-inch (130 cm^2 sign or 200 mm length; 3 mm) thickness for larger sizes. Engrave legend in white letters on black face and punch for mechanical fasteners.

I. Baked Enamel Warning and Caution Signs: Provide pre-printed aluminum signs suitable for indoor use with colors and legend appropriate to the location, punched for fasteners, and sized for good visibility.

J. Metal Backed Butyrate Warning and Caution Signs: Provide weather resistant, non-fading pre-printed cellulose acetate butyrate signs with 20 gauge (1 mm) galvanized steel backing, with colors and legend appropriate to the location, and size selected for good visibility. Provide 1/4-inch (6 mm) grommets in corners for mounting.

K. Fasteners for Plastic Laminate and Metal Signs: Provide self tapping stainless steel screws or No. 10/32 stainless steel machine screws with nuts, and flat and lock washers.

L. Cable Ties: Provide fungus-inert, self-extinguishing, one piece, self locking nylon cable ties, 0.18 inch (4.5 mm) minimum width, 50 pounds (220 N) minimum tensile strength and suitable for a temperature range from -50 degrees F. to +350 degrees F (-45EC to 175EC). Provide ties in specified colors when used for color coding.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION

A. General Installation Requirements:

1. Coordinate names, abbreviations and other designations used in electrical identification work, with corresponding designations, specified or indicated on drawings. Provide numbers, lettering and wording as approved in submittals, as required by code, or as recommended by manufacturers.

2. Install products covered by this Section where indicated on drawings or specified. Install products covered by this Section where required by NFPA 70, whether or not otherwise indicated. Install products in accordance with manufacturer's written instructions and requirements of NFPA 70.

3. Where identification is to be applied to surfaces which require finish, install identification after completion of finish work.

B. Conduit Identification:

1. Identify high voltage feeder conduits (over 600 volts) by words "DANGER-HIGH VOLTAGE" in black letters 2 inches (50 mm) high, stenciled at 10-foot (3 m) intervals over continuous painted orange background applied as follows:

a. On entire floor area directly above conduits running beneath and within 12 inches (300 mm) of basement or ground floor in contact with earth or framed above unexcavated space.

b. On wall surfaces directly exterior to conduits run concealed within wall.

c. On entire surface of exposed conduits.

d. Clean surface of dust, loose material and oil films before painting.

e. Prime unpainted surfaces. For galvanized metal use single component acrylic vehicle coating formulated for galvanized surfaces. For concrete masonry units use heavy duty acrylic resin block-filler. For concrete surfaces use clear alkali-resistant alkyd binder type sealer.

f. Provide one intermediate and one finish coat of orange silicone alkyd

enamel.

g. Apply all primer and finish materials in accordance with manufacturer's instructions.

2. Identify raceways of certain systems with color banding. Band exposed or accessible raceways of the following systems for identification. For bands, use either pre-tensioned, snap-around colored plastic sleeves, or colored adhesive marking tape or a combination of the two. Make each color band 2-inch (50 mm wide, completely encircling the conduit, and place adjacent bands of 2-color markings in contact, side-by-side. Install bands at changes in direction, at penetrations of walls and floors and at 40-foot (12 m) maximum intervals in straight runs.

Fire Alarm System	Red
Fire Suppression Supervisory and Control System	Red and Yellow
Security System	Blue and Yellow
Civil Defense System	Yellow
Mechanical and Electrical Supervisory System	Green and Blue
Telephone System	Green and Yellow

C. Identification of Junction, Pull and Connection Boxes: Provide pressure sensitive, self-adhesive labels indicating system voltage in black pre-printed on orange background as required by NFPA 70 for caution signs on all electrical power and lighting system boxes. Install on outside of box cover. Also label box covers to identify the circuits contained therein. Use pressure sensitive plastic labels at exposed locations and similar labels or plasticized card stock tags at concealed boxes.

D. Conductor Color Coding: Provide color coding for secondary service, feeder and branch circuit conductors throughout the project secondary electrical system as described in Section 16120, "Wire and Cables."

E. Power Circuit Identification: Provide identifying metal tags or aluminum wrap-around marker bands securely fastened to all cables, feeders, and power circuits in vaults, pull boxes, junction boxes, tags or bands with 1/4-inch (6 mm) steel letter and number stamps with legend to correspond with designations on drawings. If metal tags are provided, attach them with approximately 55-pound (245 N) test monofilament line or one piece self-locking nylon cable ties.

F. Tagging or Labeling Conductors: Tag or label conductors as follows:

1. Tag or label all conductors indicated for future connection (or connection under another contract) with identification indicating source and circuit numbers.

2. Where multiple branch circuits or control wiring or communications/signal conductors are present in the same box or enclosure, (except for 3 circuit, 4 wire home runs), label each conductor or cable. Provide legend indicating source, voltage, circuit number and phase for branch circuit wiring. Phase and voltage of branch circuit wiring may be indicated by means of coded color of conductor insulation. For control and communications/signal wiring use color coding or wire/cable marking tape at terminations and at all intermediate locations where conductors appear in wiring boxes, troughs and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tapes.

3. Match identification markings with designations used in panelboards, shop drawings, contract documents and similar previously established identification schemes for the facility electrical work.

G. Warning, Caution and Instruction Signs and Stencils:

1. Where required by NFPA 70, where indicated on drawings or specified, or wherever reasonably required to ensure safe operation and maintenance of electrical systems and of the items to which they connect, install warning, caution or instruction signs. Where instructions or explanations are needed for system or equipment operation, provide engraved plastic laminate instruction signs with approved legend. For outdoor items provide butyrate signs with metal backing.

2. Stencil "EMERGENCY" in 2-inch (50 mm) high red letters on the outside of cabinets housing emergency lighting or power panels.

3. Provide sign or stencilled legend to identify equipment concealed behind bolted covers of housing for disconnecting switches or links in bus ducts between network transformers and switchboards.

H. Equipment/System Circuit/Device Identification:

1. Provide equipment identification label of engraved plastic-laminate on each major unit of electrical equipment in building; including central or master unit of each electrical system. This includes communication/signal/alarm systems, unless unit is specified with its own self-explanatory identification. Except as otherwise indicated, provide single line of text, 1/2 inch (13 mm) high lettering on 1-1/2 inches (40 mm) high label (2 inches (50 mm) high where 2 lines are required), white lettering in black field. Provide text that matches terminology and numbering of the contract documents and shop drawings. Provide label for each unit of the following categories of electrical work:

   a. Panelboards, electrical cabinets and enclosures.
   b. Access doors and panels for concealed electrical items.
   c. Electrical switchgear and switchboards.
   d. Motor starters.
   e. Pushbutton stations.
   f. Power transfer equipment.
   g. Contactors.
   h. Remote controlled switches.
   i. Dimmers.
   j. Control devices.
   k. Transformers.
   l. Telephone switching equipment.

m. Call system master station.
n. TV/audio monitoring master station.
o. Fire alarm master station or control panel.
p. Security monitoring master station or control panel.

2. Provide circuit/control/item designation labels of engraved plastic laminate for all disconnect switches, breakers, pushbuttons, pilot lights, motor controls and similar items for all power distribution and control components above, except panelboards and alarm/signal components, where labeling is specified elsewhere. For panelboards, provide framed typed circuit schedules with explicit description and identification of items controlled by each individual breaker.

3. Install labels at locations as indicated on drawings or as specified. Where not so designated, install labels at locations for best convenience of viewing without interference with operation and maintenance of equipment.

4. Provide 480/277-volt panelboards with legend, and stencil "480/277 VOLTS" in 2-inch (50 mm) high yellow letters on inside of cabinet doors.

END OF SECTION 16195

SECTION 16440 - DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Extent of disconnect switch work is indicated on the drawings and schedules, by the requirements of this Section, and Section 16010, "Electrical Basic Requirements."

B. Types: Types of disconnect switches covered by this Section include the following:

1. Enclosed, heavy duty non-fused switches.
2. Enclosed, heavy duty fusible switches. .

C. Refer to other Division 16 sections for:

1. Wire and Cable
2. Raceways
3. Conduit
4. Fittings Marking

1.2 QUALITY ASSURANCE

A. National Electrical Manufacturers Association (NEMA): Provide switches conforming to NEMA KS 1, "Enclosed Switches."

B. NEMA: Construct enclosures conforming to NEMA 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)."

C. National Fire Protection Association (NFPA): Conform to NFPA 70, "National Electrical Code," for installation and minimum fusing requirements.

D. Underwriters Laboratories, Inc. (UL): Manufacture switches conforming to the requirements of UL 98, "Enclosed and Dead-Front Switches."

1. Provide switches listed and labeled by UL.
2. Provide fuse holders conforming to UL 512, "Fuseholders."
3. Provide cabinets conforming to UL 50, "Cabinets and Boxes."

1.3 SUBMITTALS

A. Division 1: Conform to the requirements of Division 1, Section 01003, "Submittals."

B. Product Data: For each switch provided on this project, furnish the manufacturer's published technical data, drawings, dimensions, and capacities.

PART 2 – PRODUCTS

2.1 MANUFACTURERS (Not Used)

2.2 SWITCHES

A. General: Provide individually enclosed air-break switches as indicated and scheduled on

the drawings, with all current-carrying parts enclosed and manually operable by means of external handles. Switches shall be heavy duty (HD) type, ampere and horsepower rated.

1. Provide cartridge enclosed fuses and rejection fuse holders when fused switches are indicated.

2. Provide NEMA 1 enclosure for indoors, NEMA 3R enclosure for outdoors, or as indicated on the drawings.

B. Ratings: Conform to NEMA KS 1 for voltage and power ratings.

1. Voltages shall be 240 600 determined by the circuit voltage.

C. Switching Action: Provide quick-make, quick-break type switch action.

D. Construction: All current carrying parts shall be high conductivity copper, with heating ratings conforming to UL 98.

1. Provide silver tungsten or silver-plated copper contacts.

2. Provide fuse holders of the rejection type, sized for fuses scheduled.

3. Provide interrupting ratings minimum 10 times locked rotor current of NEMA maximum motor horsepower rating.

4. Arrange for padlocking with two locks in either “off” or “on” position.

E. Fuses: Provide fuses of class, type and rating indicated on the drawings and schedule.

PART 3 – EXECUTION

3.1 INSTALLATION OF SWITCHES

A. Installation: Install switches in conformance with the manufacturer’s requirements and NFPA 70, paragraph, “Switches.” Provide grounding in accordance with NFPA 70.

END OF SECTION 16440

SECTION 16450 - SECONDARY GROUNDING

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Extent of the secondary grounding work required is indicated on drawings, by the requirements of this Section, and Section 16010, "Electrical Basic Requirements."

B. Types: The solid grounding specified in this Section shall be applied to the grounding of the following:

1. Underground metal piping.
2. Underground metal structures.
3. Overhead electrical systems.
4. Electrical service equipment.
5. Electrical equipment enclosures.
6. Electrically operated equipment.

C. Related Sections: Refer to other Division 16 sections for grounding and testing of the following:

1. Power Generator Equipment.
2. High and Medium Voltage Distribution Equipment.
3. Testing. .

1.2 QUALITY ASSURANCE

A. American National Standards Institute (ANSI): Comply with the requirements of:

1. C2 National Electric Safety Code.

B. American Society for Testing and Materials (ASTM): Comply with the requirements of:

1. B 1 Standard Specification for Hard-Drawn Copper Wire

2. B 2 Standard Specification for Medium-Hard-Drawn Copper Wire

3. B 3 Standard Specification for Soft or Annealed Copper Wire

4. B 8 Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

5. B 228 Standard Specification for Concentric-Lay-Stranded Copper-Clad Steel Conductors.

C. Institute of Electrical and Electronics Engineers (IEEE): Comply with the following standards which apply to the grounding of electrical systems:

1. 141 Recommended Practice for Electric Power Distribution for Industrial Plants.

2. 142 Recommended Practice for Grounding of Industrial and Commercial Power Systems.

3. 241 Recommended Practice for Electric Power Systems in Commercial Buildings.

D. National Fire Protection Association (NFPA): Comply with the requirements of NFPA 70, "National Electrical Code" for the grounding of electrical systems.

E. Underwriters Laboratories, Inc. (UL): Provide material and installation conforming to the following standards:

1. 467 Grounding and Bonding Equipment.
2. 869 Service Equipment.

F. UL Labels: Provide grounding electrodes and connectors which are UL listed and labeled.

1.3 SUBMITTALS

A. Division 1: Conform to the requirements of Division 1, Section 01003, "Submittals."

B. Product Data: Submit manufacturer's data on conductors, grounding electrodes, ground clamps, and exothermic welding devices where specified.

1.4 MATERIALS AND COMPONENTS

A. Materials: Provide an electrical system and equipment grounding system consisting of an assembly of materials including, but not limited to, cables, connectors, ground rods, bonding jumpers, and all accessories necessary to make a complete installation. All materials utilized in the grounding system shall meet the requirements of the standards listed and shall also meet established industry standards for the applications indicated.

B. Components: Provide raceways, boxes and fittings for grounding conductors. Install grounding conductors in one or more of the following types of raceway unless direct buried or exposed conductors are specified:

1. Galvanized rigid steel conduit
2. Electricmetallic tubing (EMT)
3. Flexible metal conduit (Commercial Greenfield)
4. Liquid tight flexible metal conduit

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver grounding materials in factory-sealed containers and with conductors wound on National Electrical Manufacturers Association (NEMA) wire and cable reels.

B. Storage: Store grounding materials in a clean dry space in original containers. Protect products from weather, damaging fumes, construction debris, and traffic.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (Not Used)

2.2 CONDUCTORS: WIRE AND CABLE TYPE

A. Equipment Grounding Conductors: Provide insulated equipment grounding conductors which run in the same raceway with circuit wires where indicated.

B. Bare Ground Conductors: Provide bare ground conductors for grounding of transformers, switchgear, other service equipment, grounding service poles and electrical equipment structures both underground and above ground. Conductors shall be stranded copper conductors.

C. Braided Bonding Jumpers: Provide braided copper tape constructed of No. 30 gauge (0.4 mm) bare copper wires sized to suit the application.

D. Flexible Jumper Straps: Provide flat, flexible, braided conductors consisting of minimum 480 strands of No. 30 gauge (0.4 mm) bare copper wire with 1/4-inch by 2-inch (6 mm by 50 mm) copper bus bar ends where indicated for a specific application.

2.3 GROUND BUS

A. General: Provide minimum 1/4-inch by 2-inch (6 mm by 50 mm) hard drawn copper system ground bus where indicated on the drawings.

2.4 BONDING PLATES, CONNECTORS, TERMINALS AND CLAMPS

A. General: Provide copper bonding plates, connectors, terminals, lugs, and clamps meeting the requirements of NFPA 70 and UL to provide a complete secondary grounding system shown on the drawings.

2.5 GROUND RODS

A. Solid Copper Ground Rod: Provide solid copper type ground rods minimum 5/8-inch (16 mm) in diameter by a minimum of 10 feet (3 m) long.

B. Copper Clad Steel Ground Rod: Provide copper clad steel ground rods minimum 3/4-inch (19 mm) in diameter by a minimum of 10 feet (3 m) long.

C. Stainless Steel Ground Rod: Provide minimum 3/4-inch (19 mm) diameter by 10 feet (3 m) long stainless steel ground rods where indicated.

D. Multiple Ground Rods: Where the grounding resistance specified on the drawings can not be achieved with a single rod, provide multiple ground rods as necessary to achieve the level of ground resistance required.

E. Ground Rod Identification: On each ground rod provided, the manufacturer shall die stamp, near the top, his name or trademark and the length of the rod in feet (millimetre). All rods shall have a hard, clean, smooth continuous surface throughout the entire length of the rod.

2.6 FIELD WELDING

A. General: Where welded connections are indicated or required, such as buried connections to cables or ground rods, such welds shall be made by the exothermic process utilizing factory provided molds.

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Examine all areas and conditions under which electrical grounding connections are to be made. Do not proceed with the grounding work until such unsatisfactory conditions have been corrected.

3.2 GROUNDING SECONDARY BUILDING SERVICE

A. General: Supplement the grounded neutral of the secondary distribution system with an equipment grounding system to properly safeguard equipment and personnel. The system shall, as a minimum, comply with NFPA 70. Where the drawings exceed the requirements of NFPA 70 the drawings take preference.

B. Ground Fault Currents: Provide the equipment grounding system such that all metallic structures, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, portable equipment, and other conductive items in close proximity with electrical circuits operate continuously at ground potential and provide a low impedance path for possible ground fault currents.

C. Ground Bus: Provide where indicated, a minimum 2-inch by 1/4-inch (6 mm x 50 mm) bare copper ground bus spaced 1 inch (25 mm) from the wall and not more than 6 inches (150 mm) above the finished floor in each transformer room and switchgear room. The required length of the ground bus shall be as shown on the drawings. Connect the ground bus to at least three minimum 3/4-inch by 10 feet (19 mm by 3 m) long driven ground rods by utilizing bare hard-drawn copper conductors or insulated conductors in conduit. Make connections between the ground bus and the ground rods by exothermic welds on both ends of the ground conductors.

D. Ground Rods: Locate the ground rods a minimum of one rod length from each other and at least the same distance from any other grounding electrodes. Interconnect the ground rods with bare copper conductors buried at least 24 inches (600 mm) below grade.

Connect the bare cable ground loop to the ground rods by means of exothermic welds.

E. Testing: Test the installation for resistance to ground. Where the resistance exceeds the resistance to ground specified on the drawings provide additional ground rods at no additional cost.

F. Metallic Water Service Pipe: Provide a minimum No. 3/0 AWG green insulated copper ground conductor in conduit from the building main service equipment, or the ground bus, to the main metallic water service entrance. Connect this ground conductor to the main metallic water service pipe by means of an adequate ground clamp. Where a dielectric main water fitting is installed, connect this ground conductor to the street side of the fitting. Do not install a grounding jumper around this fitting. Bond the conduit to the ground conductor at each end. Provide a jumper with ground clamps around the water meter.

G. Common Ground Bus: Connect the system neutral ground and the equipment ground system to the common ground bus as indicated on the drawings. Where the connection is not shown, provide connection as required by NFPA 70.

H. Secondary Service Grounding: Ground secondary services at the supply side of the secondary disconnecting means and at the related transformers in accordance with the requirements of NFPA 70. Provide each service disconnect enclosure with a neutral disconnecting means and an insulated neutral stud which interconnects with the insulated neutral and uninsulated equipment ground buses to establish the system common ground point. Locate the neutral disconnecting link or links so that the low voltage switchgear neutral bar with all interior secondary neutrals can be isolated from the common ground bus and from the service entrance conductors.

3.3 GROUNDING SECONDARY DISTRIBUTION

A. General: Size all required equipment grounding conductors and straps in compliance with NFPA 70. Provide green colored insulation on all equipment grounding conductors of the same type and class as that specified for the associated phase and neutral conductors of the secondary distribution system. Braze or connect the feeder and branch circuit grounding conductors to the ground bus with approved pressure connectors.

B. Grounding Conductor: Provide a continuous grounding conductor for each feeder serving several panelboards. Connect this ground conductor to each related cabinet ground bar.

C. Insulated Equipment Grounding Conductor: Provide a separate green insulated equipment grounding conductor for each single or three phase feeder and each branch circuit with a three phase protective device. Install the required grounding conductor in the common conduit with the related phase and neutral conductors. Where parallel feeders are installed in more than one raceway, provide a green insulated equipment grounding conductor in each raceway.

D. Single Phase Branch Circuits For Lighting: Provide single phase branch circuits required for 120 and 277 volt lighting consisting of phase and neutral conductors installed in a common metallic conduit which shall serve as the grounding conductor.

E. Single Phase Branch Circuits For Receptacles, Motors and Other Similar Equipment: Provide single phase branch circuits serving receptacles, motors, and other similar equipment consisting of phase, neutral, and green insulated equipment ground conductor installed in a common conduit.

F. Flexible Metallic Conduit: Provide flexible metallic conduit equipment connections utilized in conjunction with single phase branch circuits with green insulated grounding conductors connected to suitable grounding terminals at each end of the flexible conduit.

G. Pressure Connectors: Provide the number and size of pressure connectors required for all equipment grounding bars in panelboards and other electrical equipment for the termination of equipment grounding conductors. Provide pressure connectors for all active and all spare circuits.

3.4 BRANCH CIRCUIT GROUNDING REQUIREMENTS

A. General: Provide, in the same raceway with the associated phase and neutral conductors, a green colored equipment ground conductor having the same type and class insulation as the associated branch circuit conductors. Provide each ground conductor with spade type terminals or solderless pressure connectors to suit the requirements of the circuit.

B. Branch Circuit Ground Conductors: Connect ground conductors for branch circuits as follows:

1. Connect the ground conductor, accompanying the circuit serving the receptacle, to a green "washer-in-head" machine screw threaded to the receptacle outlet box. Extend a green insulated ground wire from the ground terminal on the receptacle to this ground screw. Receptacles with special cast boxes having factory designed and approved ground paths shall not require a separate ground jumper.

2. Provide an insulated ground wire from the green No. 10-32 machine screw in each ceiling outlet box or above ceiling junction box through the stem or flexible conduit to the ground terminal on each luminaire.

3. Provide an insulated ground wire from the ground terminal in the associated junction box or disconnect enclosure to a motor through the flexible conduit connection.

4. From the associated motor starter to each motor provide an insulated ground conductor in the same conduit as the associated phase conductors. Connect to the starter enclosure and the motor connection box. Originate the ground conductor at the ground bus of the panelboard serving the motor and bond to all intermediate devices.

5. Provide a green insulated ground conductor from the equipment ground bus in each motor control center through conduit and flexible metallic conduit to the ground terminal in the connection box mounted on each motor.

6. Provide a green insulated ground wire from the ground bus in the switchgear, switchboard, or distribution panel to the equipment ground bar on a busway.

Make all connections between the ground buses in an approved manner.

7. Provide a separate green insulated ground wire from a computer area power panel ground bus through each branch circuit connected to this power panel. Size these ground conductors as required by NFPA 70, but provide conductors and connections of sufficient size to ensure that no ground circuit shall exceed 3 ohms resistance between the final connection point and the building grounding system. Where the 3 ohm limit is exceeded, provide larger conductors at no additional cost.

8. Provide a green insulated grounding conductor to all electric devices such as electric air cleaners or heaters. Where these devices are installed in air ducts, bond the conductor to each such unit, the air duct, and to the ground bus in the associated panelboard.

3.5 TERMINATIONS AT EQUIPMENT WITHOUT PROVISION FOR GROUND CONDUCTOR TERMINATION

A. General: Where metallic conduits terminate at a metallic housing without mechanical connection, such as locknuts and bushings, provide each conduit with a ground bushing. Connect each such ground bushing with a bare copper conductor to the ground bus in the electrical equipment. Size the conductor as required by NFPA 70. Bond electrically noncontinuous conduits at both entrance and exit with a ground bushing and bare jumper as described.

3.6 TESTING

A. General: Subject the completed equipment grounding system to a megger test at each service disconnect enclosure ground bar to ensure that the ground resistance without chemical treatment or other artificial means does not exceed the level specified.

B. Ground Test: Provide certified test reports of the ground resistance at each service enclosure ground bus. Modify the grounding system as required to meet the specified resistance levels.

END OF SECTION 16450

SECTION 16461 - TRANSFORMERS - GENERAL PURPOSE DRY TYPE

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Extent of transformer work is indicated on the drawings, in schedules, by the requirements of this Section, and Section 16010, "Electrical Basic Requirements."

B. Types: Types of transformers specified in this section are general purpose dry type.

C. Related Sections: Refer to other Division 16 sections for the following:

1. Grounding
2. Primary and secondary protective devices

1.2 QUALITY ASSURANCE

A. American National Standards Institute (ANSI): Construct and test transformers in accordance with the following ANSI standards:

1.	C2	National Electrical Safety Code
2.	C57.12.01	General Requirements for Dry Type Distribution and Power Transformers
3.	C57.12.91	Test Code for Dry Type Distribution and Power Transformers

B. Installation: Install transformers in accordance with ANSI C57.94, "Recommended Practice for Installation, Application, Operation, and Maintenance of Dry-Type General Purpose Distribution and Power Transformers."

C. National Electrical Manufacturers Association (NEMA): Manufacture transformers in accordance with the following requirements:

1. ST 20 Dry-Type Transformers for General Applications

D. National Fire Protection Association (NFPA): Comply with applicable sections of NFPA 70, "National Electrical Code" for electrical work and Article 450 which pertain directly to transformers of the size, type, rating and style required by this project.

E. Underwriters Laboratories, Inc. (UL): Provide general purpose dry type transformers which have been UL listed and which have the UL label affixed. As a minimum these transformers shall comply with the requirements of UL 506, "Specialty Transformers."

1.3 SUBMITTALS

A. Division 1: Conform to the requirements of Division 1, Section 01003, "Submittals."

B. Product Data: Submit manufacturer's technical product data for each transformer shown on the drawings or shown in the transformer schedule. This data as a minimum shall include:

1. Rated transformer kVA
2. Primary voltage
3. Secondary voltage
4. Tap voltages polarity

C. Certified Test Reports: Provide certified test reports showing satisfactory compliance with all factory tests required including the following:

1. Percentage regulation at 100 percent power factor.
2. Percentage regulation at 80 percent power factor.
3. No load loss in watts.
4. Full load loss in watts.
5. Sound pressure level in decibels.
6. Impedance at 75EC hot spot temperature.
7. Average temperature rise above 40EC ambient.

D. Shop Drawings: Submit manufacturer's drawings indicating dimension, weights, layout, mounting, and supports.

E. Wiring Diagrams: Submit wiring, protection and control diagrams for transformers. Clearly differentiate between portions of wiring that are manufacturer installed at factory and those portions which are field installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (Not Used)

2.2 POWER AND DISTRIBUTION TRANSFORMERS - DRY TYPE

A. General: Provide air-cooled, dry type, power and distribution transformers having sizes and ratings as shown on the drawings and in the transformer schedule.

B. Taps: Provide transformer taps which permit transformers to deliver rated kVA at any tap setting in accordance with NEMA standards. Provide, as a minimum, the following:

1. Four 2-1/2 percent full capacity taps below rated primary voltage.
2. Two 2-1/2 percent full capacity taps above rated primary voltage.

C. Sound Level: Sound levels on transformers shall conform to the NEMA standard sound levels for the transformer sizes indicated. Provide transformers having integral vibration, noise isolating and dampening supports.

D. Voltage Rating: Provide transformers with voltage ratings conforming to Contract requirements:

1. Provide three-phase transformers with 480 volt Delta primary; 208/120 volt wye secondary.

2. Provide K-13 rated dry-type transformers for harmonic loads where indicated on

the drawings. Transformers shall be equipped with electrostatic shielding and a neutral rated for 200 percent of phase current. The maximum hot-spot temperature shall not exceed 220 degrees C under full-rated harmonic load. Terminal provisions shall be suitable for two (2) neutral conductors.

E. Temperature Rise: For transformers 15 kVA and larger provide 115EC temperature rise above a 40EC ambient. Transformers shall be able to carry 15 percent continuous overload without exceeding 150EC rise in a 40EC ambient. All insulating materials shall be in accordance with NEMA ST 20 for 220EC.

F. Construction: Provide transformers with the following construction:

1. Provide coils with continuous wound construction impregnated with non-hygroscopic thermosetting varnish.
2. Construct cores of high-grade non-aging silicone steel with high magnetic permeability and low hysteresis and eddy current loss. Maintain magnetic flux densities below saturation level.
3. Clamp core laminations together with structural steel angles. Bolt the core and coil to the base of the transformer enclosure, and isolate from enclosure by means of rubber vibration isolating mounts. There shall be no metal to metal contact between the core and the enclosure.
4. Sound isolating systems requiring complete removal of all fastening devices will not be acceptable.

G. Enclosures: Provide sheet steel enclosures as follows:

1. For transformers 15 kVA and larger provide 2 mm gauge sheet steel ventilated enclosure. Provide ventilating openings designed to prevent accidental access to live parts in accordance with UL, NEMA, and NFPA 70.
2. For transformers 75 kVA and smaller, design enclosures for either wall or floor mounting.
3. For transformers larger than 75 kVA, design enclosures for floor mounting.
4. Degrease, clean, phosphatize, prime, and finish enclosures with gray baked enamel.

H. Grounding: Ground transformer cores to enclosures by means of flexible grounding conductors sized in accordance with applicable NEMA, Institute of Electrical and Electronics Engineers (IEEE), and ANSI standards. Ground strap shall be visible when wiring compartment is open.

2.3 TESTING

A. Factory Tests: Tests classified "routine" in NEMA ST 20 shall be performed on each transformer. Submit certified reports of the test results.

B. Tests: As a minimum, the following tests shall be performed:
1. Ratio test.
2. Polarity test.
3. Phase relation test.
4. Exciting current.

5. No load loss test.
6. Load loss impedance.
7. Regulation.
8. Applied potential.
9. Induced potential.

PART 3 - EXECUTION

3.1 INSTALLATION OF TRANSFORMERS

A. Manufacturer's Instructions: Install transformers as indicated, complying with manufacturer's written instructions, applicable requirements of NFPA 70, NEMA, ANSI, and IEEE standards, and in accordance with recognized industry practices to ensure that products fulfill requirements.

3.2 GROUNDING

A. General: Provide equipment grounding connections as indicated on the drawings and as required by NFPA 70. Make all grounding connections by means of exothermic welds.

END OF SECTION 16461

SECTION 16470 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Extent of panelboard work is indicated on the drawings and schedules, by the requirements of this Section, and Section 16010, "Electrical Basic Requirements."

B. Types: Types of panelboards and enclosures covered under this Section include the following:

1. Panelboards with automatic circuit breakers.

C. Related Sections: Refer to other Division 16 sections for the following:

1. Cable and Wire.
2. Raceways.
3. Connectors.

1.2 QUALITY ASSURANCE

A. National Electrical Manufacturers Association (NEMA):

1. AB 1 Molded Case Circuit Breakers and Molded Case Switches

2. PB 1 Panelboards

B. National Fire Protection Association (NFPA): Conform to the requirements of NFPA 70, "National Electrical Code."

C. Underwriters Laboratories, Inc. (UL): Construct panelboards in conformance with the following UL publications:

1. UL 50 Cabinets and Boxes

2. UL 67 Panelboards

3. UL 310 Electrical Quick-Connect Terminals

4. UL 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors

5. UL 489 Molded-Case Circuit Breakers and Circuit-Breaker Enclosures

6. UL 943 Ground-Fault Circuit Interrupters

7. UL 1053 Ground-Fault Sensing and Relaying Equipment

1.3 SUBMITTALS

A. Division 1: Refer to Section 01003, "Submittals," for additional requirements.

B. Product Data: Submit manufacturer's data on panelboards including:

1. Manufacturer's materials specifications.
2. Certification for compliance with referenced standards.
3. Enclosure type.
4. Breaker types.
5. Switch size.
6. Bus ampacity.
7. Voltage rating.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (Not Used)

2.2 PANELBOARDS

A. Buses: Provide panelboards with buses constructed of solid copper, minimum conductivity 98 percent and rectangular shape.

1. Mechanically mount and brace buses in conformance with UL 67.

2. Provide solderless lugs for copper or aluminum cable.

3. Provide ampacity as scheduled on the drawings.

B. Grounding Bus: Provide bare, uninsulated copper, factory installed grounding bus with ampacity equal to the main bus.

1. Provide copper pressure connected terminations.

C. Bus Sequencing: Provide bus bar connections to branch circuits of the sequenced phased type.

1. Mount in accordance with UL 67.
2. Provide numbered terminals.
3. Provide pressure connectors, copper.

D. Spaces: Where words similar to "space," "space only," "future space" or similar wording are used on the drawings and panel schedules, provide bus space for future overcurrent devices.

1. Extend buses full size.
2. Brace and insulate bus in accordance with UL 67.
3. Provide bolted connections for future overcurrent devices.

E. Enclosures: Construct in accordance with UL 50 except modify as hereinafter specified.

1. Construct of minimum 16-gauge (1.5 mm) galvanized steel.
2. Conform to UL 67 for additional enclosure requirements.

F. Knockouts: Provide multiple knockouts not fewer than 1.5 times the number of bus circuits.

G. Painting: In addition to galvanizing or priming coat, all inside and outside surfaces of trim and doors shall be given a factory finish coat of gray paint. Recessed boxes, and surface boxes in transformer vaults, switchgear rooms and electrical closets may be galvanized or painted as described above.

H. Directories: Provide waterproof, white cardboard stock, factory printed directories with a clear plastic directory cover and metal frame attached to the panel door.

I. Wiring Space: Conform to the requirements of UL 67. Feed-through gutters not permitted.

1. Conform to NFPA 70 for maximum gutter fill.

2. Conform to UL 67 for minimum width of gutter and wire bending space.

J. Manufacturer: Panelboard, back-box and front plate shall be the product of one manufacturer. Factory fit components before shipment.

K. Enclosure Type: Provide enclosure type in conformance with UL 50 and NEMA PB 1.

L. Common Feeders: Where multiple panels are served by a common feeder, provide an auxiliary gutter.

M. Front Plates: Provide removable front plates of the dead-front type with removable, adjustable cadmium plated trim clamps, and flush hinged enclosure door.

N. Single Front Plate: On panelboards up to 48 inches (1200 mm) in width, provide a single front plate with multiple doors attached to a single back-box.

O. Multiple Front Plates: On panels wider than 48 inch,(1200 mm), provide a single back-box, multiple sectionalized front plates and multiple doors.

P. Doors: On doors 48 inches (1200 mm) in height or greater, provide vault handle and three point catch.

2.3 DISTRIBUTION PANELBOARDS WITH AUTOMATIC CIRCUIT BREAKERS

A. General: Conform to the requirements of this Section, the drawings and panel schedules.

B. Circuit Protective Devices: Provide molded case circuit breakers conforming to UL 489.

1. Conform to NEMA AB 1. Provide breakers with trip ratings and the number of poles indicated on the drawings and schedules.

2. Provide quick-make and quick-break mechanism, bolt-on type.

3. Breakers shall have inverse time automatic tripping.

4. Provide adjustable trip circuit breakers as scheduled.

5. Circuit breakers shall be bolt-in type, factory assembled, except breakers 225 amperes frame size and larger may be plug-in type if held in place by positive locking device requiring mechanical release for removal.

6. Provide integrally fused circuit breakers with inverse time automatic tripping, and fuses conforming to UL 198B, 198C, 198D, 198E, 198F, 198G, 198H, 198L, and 198M.

7. Provide circuit breakers integrally fused with instantaneous automatic tripping fuses, current limiting type.

C. Current Interrupting Rating: Provide breakers as scheduled with current interrupting ratings, in rms symmetrical amps.

2.4 BRANCH CIRCUIT PANELBOARDS WITH AUTOMATIC CIRCUIT BREAKERS

A. Provide panelboards for lighting and appliance branch circuits conforming to the requirements of this Section, the drawings and schedules.

B. Circuit Protective Devices: Provide molded case circuit breakers conforming to UL 489 and NEMA AB 1; voltage and poles as scheduled.

1. Provide interrupting ratings on schedules.

2. Provide common trip mechanisms for multi-pole breakers.

3. Provide instantaneous automatic trips conforming to NEMA AB 1.

4. Provide breakers with adjustable trip settings as scheduled.

5. Breakers shall be bolt-on type, factory assembled.

6. Stab-in circuit breaker types are not acceptable.

7. Provide branch circuit arrangement as scheduled.

8. Provide quick-make and quick-break mechanism.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards in conformance with NEMA PB 1, and NFPA 70.

B. Lug Torquing: Torque lug screws in accordance with UL 486A for copper conductors and UL 486B for aluminum conductors. Install connectors, lugs, neutral bus and other field installed components in accordance with manufacturer's published literature.

C. Wiring: Refer to drawings for feeder and branch circuit wiring.

1. Verify gutter size conforms to wire bending space requirements of NFPA 70 and UL 67.

2. Wire wrap branch circuit in gutters after installation. Use approved wire ties.

3. Verify maximum gutter fill to conform with NFPA 70 and UL 67.

4. Verify bolted circuit breaker connection lugs conforming to shop drawings.

5. Verify breaker size, trip setting, and breaker type in conformance with schedules.

6. Complete typewritten panelboard circuit directory prior to project acceptance.

7. Only wires made of the conductor material for which the panelboard terminals have been marked shall be used.

3.2 GROUNDING

A. Provide equipment grounding connections for panelboards as indicated on drawings or schedules.

1. Conform to the requirements of NFPA 70.

2. Install lugs and ground connectors in conformance with UL 486A and UL 486B.

3.3 ADJUSTABLE TRIP SETTINGS

A. Verify factory settings for adjustable trip breakers.

B. Field adjust in conformance with manufacturer's recommendations, if necessary.

3.4 NAMEPLATES

A. Identification: Provide rigid engraved plastic nameplates conforming to the requirements of Section 16195, "Electrical Identification," for each panelboard.

END OF SECTION 16470

SECTION 16475 - OVERCURRENT PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Extent of overcurrent protective device work required is indicated on drawings and schedules, by requirements of this Section, and Section 16010, "Electrical Basic Requirements."

B. Types: Types of overcurrent protective devices specified in this Section include the following:

1. Molded case circuit breakers.
2. Fuses.
3. Quick-make, quick-break fusible load interrupter switches.

C. Related Sections: Refer to other Division 16 sections for the following:

1. Switchboards.
2. Panelboards
3. Combination Starters.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Provide overcurrent protective devices conforming to the following:

1. National Electrical Manufacturers Association (NEMA): Provide and install fuses and circuit breakers conforming to NEMA, including:

a. AB 1 Molded Case Circuit Breakers and Molded Case Switches

b. AB 2 Field Inspection and Performance Verification of Molded Case Circuit Breakers Used in Commercial and Industrial Applications, Procedures for.

c. AB 3 Molded Case Circuit Breakers and Their Application.

d. FU 1 Low Voltage Cartridge Fuses.

2. National Fire Protection Association (NFPA): Comply with NFPA 70, "National Electrical Code" requirements as applicable to construction and installation of overcurrent devices.

3. Underwriters Laboratories, Inc. (UL): Provide overcurrent protective devices that are UL-listed and labeled. Provide fuses and circuit breakers conforming to UL including:

a. 198B Class H Fuses

b. 198C High-Interrupting-Capacity Fuses, Current-Limiting Types

c. 198D Class K Fuses

d. 198E Class R Fuses

e. 198G Fuses for Supplementary Overcurrent Protection

f. 198H Class T Fuses

g. 198M Mine-Duty Fuses

h. 489 Molded-Case Circuit Breakers and Circuit-Breaker Enclosures.

B. Protective Equipment Coordination: Obtain catalog cuts, melting time and let-through characteristic curves, dimensions, mounting requirements, test data, and fuse selectivity ratios from the several fuse manufacturers whose units are proposed for installation as necessary for compliance with these specifications.

1. This data shall be submitted for approval and the approved data furnished to the associated equipment manufacturers for their concurrence and inclusion on their shop drawings.

2. These shop drawings shall be prepared in accordance with the Contractor's instructions and include the specific fuse locations, type, manufacturers and ratings.

3. The test data may be waived if all the project fuses are supplied by the same manufacturer and proper selectivity with the associated protective equipment may be substantiated by published catalog data.

C. Motor Short Circuit Fuse Coordination:

1. The switch sizes and fuse ratings shown on the drawings and/or specified are based on general values for each motor horsepower.

2. Since the characteristics of fuses for motor short circuit protection vary with different manufacturers, coordinate the fuse values with the switch sizes for each motor in the project.

3. Obtain data from the particular manufacturer of fuses proposed and recommended fuse ratings.

4. Where there is a discrepancy between the Contract documents and the fuse manufacturer's recommendations, the fuse manufacturers recommendations shall be followed.

5. Any required revisions to the switch sizes to accommodate the recommended fuse values shall also include the necessary revisions to the assembled equipment of which the switch is a part, with no increase in cost.

6. Furnish the necessary data on any changes to all manufacturers of equipment incorporating switch-fuse units in their product, to insure a completely coordinated final installation.

7. All necessary changes in switch sizes shall be submitted for approval.

8. Certify that all motor circuits have adequate short circuit protection with the fuses furnished.

1.3 SUBMITTALS

A. Division 1: Conform to the requirements of Division 1, Section 01003, "Submittals."

B. Product Data: Submit manufacturer's data on overcurrent protective devices, including amperes, voltages and current ratings, interrupting ratings, current limitations, internal inductive and noninductive loads, time-current trip characteristic curves, and mounting requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protection: Use all means necessary to protect the overcurrent protective devices before, during and after installation and to protect the installed work and materials of all other trades.

B. Replacement: In the event of damage, make all necessary repairs and replacements at no additional cost.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (Not Used)

2.2 MOLDED CASE CIRCUIT BREAKERS

A. General: Provide molded case circuit breakers conforming to UL 489.

1. Circuit breakers shall conform to NEMA AB 1.

2. Circuit breakers shall have trip rating and number of poles as indicated on the drawings and schedules.

3. Unless otherwise specified, circuit breakers shall have an interrupting current rating equal to or greater than the available fault current at their location in the electrical system. Provide a minimum rating of 10,000 amperes symmetrical, unless a greater rating is shown on the drawings.

4. Circuit breakers shall be bolt-in type, factory assembled, except breakers 225 amperes frame size and larger may be plug-in type if held in place by positive locking device requiring mechanical release for removal.

5. All similar circuit breakers shall be of the same manufacturer.

B. Tripping Mechanisms: Provide circuit breakers with a quick-make and quick-break toggle mechanism with inverse-time trip characteristics.

1. Automatic release is to be secured by a bimetallic thermal element releasing the mechanism latch.

2. A magnetic armature shall be provided to trip the breaker instantaneously for short-circuit currents above the overload range.
3. Automatic tripping shall be indicated by a handle position between the manual OFF and ON position.

C. Adjustable Magnetic Trip Devices: Provide adjustable magnetic trip devices adjusted at the factory to "low" trip setting ampere values.

2.3 FUSES

A. General: Provide fuses that conform to UL 198B, 198C, 198D, 198E, 198F, 198G, 198H, 198L, and 198M. Provide fuses of the sizes noted on the drawings.

1. Current-limiting fuses shall be installed in lieu of regular fuses where the fault current exceeds 10,000 RMS amperes.

2. Fuses rated over 600 amperes shall be NEMA Class L.

3. Unless otherwise specified, fuses for use with switches rated 600 amperes and less shall be UL Class J RK-5 RK-1. Class RK-5 RK-1 fuses shall be dual element type with minimum time-delay of ten seconds at 500 percent of rating.

4. Provide one complete set of fuses installed for all switches requiring fuses. Provide six spare fuses of each size and type installed. The spare fuses shall be delivered in the original boxes.

2.4 QUICK-MAKE, QUICK-BREAK FUSIBLE LOAD INTERRUPTER SWITCHES

A. General: Provide quick-make, quick-break fusible load interrupter switches with current-limiting fuses as indicated on the drawings and as specified below.

1. Provide an integrated switch and fuse device rated as indicated on the drawings, with load breaking capacity in excess of the normal horsepower rating for each switch rating and the ability to withstand without damage, the let-through current available before its fuse operates when subject to faults up to 100,000 RMS symmetrical amperes.

2. Provide front operation by means of an external operating handle and an interlocking mechanism that allows access to deenergized fuses and contacts only when in the "off" position.

3. Provide UL Class L J RK-1 fuses as indicated on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION OF OVERCURRENT PROTECTIVE DEVICES

A. General: Install overcurrent protective devices as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to ensure that protective devices comply with requirements. Comply with NFPA 70 and NEMA standards for installation of overcurrent protective devices.

B. Coordination: Coordinate with other work, including electrical wiring work, as necessary to interface installation of overcurrent protective devices with other work.

C. Fastening: Fasten circuit breakers without causing mechanical stresses, twisting or misalignment being exerted by clamps, supports, or cabling.

D. Field Adjustable Circuit Breakers: Set field-adjustable circuit breakers for trip settings as indicated, subsequent to installation of units.

3.2 ADJUST AND CLEAN

A. General: Inspect circuit-breaker operating mechanisms for malfunctioning and, where necessary, adjust units for free mechanical movement.

3.3 FIELD QUALITY CONTROL

A. Testing: Prior to energization of overcurrent protective devices, test devices for continuity of circuitry and short-circuits. Correct malfunctioning units, and then demonstrate compliance with requirements.

END OF SECTION 16475

SECTION 16482 - MOTOR STARTERS

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Extent of motor starter work is indicated on the drawings and schedules, by the requirements of this Section, and Section 16010, "Electrical Basic Requirements."

B. Types: Types of motor starters specified in this Section include the following:

1. Manual
2. Magnetic full voltage
3. Combination starters
4. Magnetic star-delta
5. Magnetic reduced voltage

C. Other Divisions: Refer to Division 15 sections for the following work:

1. Starters furnished as an integral part of mechanical equipment. Starters for centrifugal refrigeration machines.

D. Related Sections: Refer to other sections of Division 16 for the following:

1. Switches and Disconnects.

1.2 QUALITY ASSURANCE

A. National Electrical Manufacturers Association (NEMA): Provide starters and controllers conforming to the following NEMA standards.

1. ICS 2 Standards for Industrial Control Devices, Controllers and Assemblies.

2. 250 Enclosures for Electrical Equipment (1,000 Volts Maximum).

B. Underwriters Laboratories, Inc. (UL): Provide fuses conforming to the following:

1. 198B Class H Fuses

2. 198C High-Interrupting-Capacity Fuses, Current-Limiting Types

3. 198D Class K Fuses

4. 198E Class R Fuses

5. 198G Fuses for Supplementary Overcurrent Protection

6. 198H Class T Fuses

C. Provide starters conforming to UL 508 "Industrial Control Equipment."

D. Provide motor starters and components UL listed and labeled.

1.3 SUBMITTALS

A. Division 1: Refer to Section 01003, "Submittals," for basic information relating to submittal requirements.

B. Product Data: Submit manufacturer's data on all motor starters indicated or scheduled. For each starter show the following:

1. Type.
2. NEMA size.
3. Enclosure.
4. Pilot lights.
5. Selector switches.
6. Disconnect switches.
7. Circuit breakers.
8. Instruments.
9. Control transformer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (Not Used)

2.2 STARTERS: GENERAL

A. Starters: For each motor scheduled or indicated provide a motor starter.

B. Types: Provide types indicated and coordinate each starter with motor characteristics and control requirements.

C. Contacts: Equip each starter with contacts to break each ungrounded line to the motor.

D. Overcurrent Trips: Provide thermal overcurrent devices, in each phase, to open all contacts simultaneously. Equip starters with a manual overcurrent trip reset button. Size overcurrent trips to match motor nameplate amperes, in accordance with the requirements of National Fire Protection Association (NFPA) 70, "National Electrical Code."

E. Enclosures: Unless otherwise specified or indicated, provide each starter in a NEMA Type 1 general purpose enclosure. Examine the drawings and schedules for enclosure types.

F. Construction: Design and construct starters as follows:

1. For each starter provide doors arranged for padlocking and with a cardholder for starter identification. Provide an external reset mechanism, "start-stop" pushbuttons for manually controlled motors, and hand-off-automatic ("H-O-A") switch for automatically started motors. Provide green "stop," red "run" pilot lights of the heavy duty oil-tight diode or resistor type.

2. Make connections to the selector switch such that only the manual automatic regulatory control devices will be bypassed when the switch is in the "hand"

position. Control safeties cannot be bypassed.

3. All safety control devices, such as low and high pressure cutouts, high temperature cutouts, and motor overload protectors, shall be connected in the motor control circuit in both the "hand" and the "automatic" positions.

4. Control circuit connections to any "hand-off-automatic" selector switch or to more than one automatic regulatory control device shall be made in accordance with an indicated, or a manufacturer's approved, wiring diagram.

5. Provide the selector switch with means for locking in any position.

6. The controller disconnecting means shall be capable of being locked in the "open" position. For each motor not in sight of the controller, provide a manually operated, nonfused switch which will disconnect the motor from the source of supply and which is placed within sight of the motor location.

7. Overload protective devices shall give adequate protection to the motor windings, be of the thermal inverse-time-limit type, and include a manual-reset type pushbutton on the outside of the motor controller case.

8. The cover of a combination motor controller and manual switch or circuit breaker shall be interlocked with the operating handle of the switch or circuit breaker so that the cover cannot be opened unless the handle of the switch or circuit breaker is in the "off" position.

9. Provide each magnetic starter with a control transformer located within the starter enclosure and with wiring extended to associated accessories and to terminal boards for remotely located accessories.

2.3 MAGNETIC FULL VOLTAGE STARTERS

A. General: Conform to the requirements of paragraph, "Starters: General."

B. Type: Provide starters of the full voltage magnetic across-the-line type, with undervoltage release and auxiliary contacts indicated or specified, and of sizes indicated on the drawings.

C. Jog Function: Provide starter jog function complying with the following:

1. Provide a remote "jog" pushbutton station in approved enclosure at each motor 375 W and larger when the starter is not within sight of the motor.

2. For automatically controlled motors the "jog" pushbutton station shall consist of a momentary contact unit.

3. For manually controlled motors the "jog" pushbutton shall consist of a double circuit unit with a jogging attachment.

4. The normally closed contact shall be connected in series with the maintaining circuit interlock on the starter and the normally open contact shall be connected to the magnetic coil on the starter so that, when the "jog" button is depressed, the normally open contacts energize the starter magnetic coil but the normally closed contacts disconnect the lock-in contacts.

5. When the button is released, the starter shall immediately open to disconnect the motor from the line.

6. The jogging attachment shall prevent the normally closed contact of the button from reclosing until a lever is operated.

7. Alternate methods may be used to accomplish the same function; however, no "Stop" button shall be used.

2.4 MAGNETIC STAR-DELTA STARTERS

A. General: Conform to the requirements of "Starters: General," article, of this Section.

B. Sizes: Provide Star-Delta starters of capacities, ratings and NEMA sizes indicated on the drawings or specified.

C. Type: Provide Star-Delta starters to include "Star" (Y) connection "Start" and "Delta" connection "Run," close transition type, with three multi-pole contactors.

1. Provide adjustable pneumatic tuners.
2. Provide three-phase overload protection relays.
3. Provide terminal strip for control and interlock wiring.
4. Provide red run pilot light.

2.5 REDUCED VOLTAGE STARTERS

A. General: Conform to the requirements of "Starters: General," article, of this Section.

B. Type: Reduced-voltage starters shall be of the single-step closed transition autotransformer, reactor, or resistor type, and shall have an adjustable tune interval between application of reduced and full voltages to the motors.

1. Provide adjustable pneumatic tuners.
2. Provide three-phase overload protection relays.
3. Provide terminal strip for control and interlock wiring.
4. Provide red run pilot light.
5. Provide ammeter and voltmeter with phase selector switches.

2.6 MANUAL STARTERS

A. General: Conform to the requirements of "Starters: General," article, of this Section.

B. Maximum Size: Use manual starters for motors less than 1/2 horsepower (0.375 Kw) unless otherwise indicated.

C. Type: Provide manual starters as follows:

1. Manually operated quick-make, quick-break toggle mechanism.

2. One piece melting alloy thermal switch.

3. Double break silver alloy contacts.

4. Red run pilot light.

5. Arrange for padlocking "Off."

6. Horsepower rate per NEMA standards.

7. NEMA Type 1 general purpose enclosure unless otherwise indicated or specified.

2.7 COMBINATION STARTERS

A. General: Conform to the requirements of "Starters: General," article, of this Section.

B. Arrangement: Combination starters shall consist of a magnetic starter of the type indicated on the drawings and a disconnect switch mounted in a common NEMA enclosure. Switch shall be fused or unfused as indicated on the drawings or schedules.

C. Type: Provide combination starters to include:

1. Circuit breakers, molded case type, conforming to UL 489, "Molded-Case Circuit Breakers and Circuit-Breaker Switches," where indicated.

2. Switches conforming to UL 98, "Enclosed and Dead-Front Switches," where indicated.

3. Fuse holders conforming to UL 512, "Fuseholders," and fuses conforming to UL 198B, 198C, 198D, 198E, 198F, 198G, 198H, 198L, and 198M.

4. External switch operating handle.

5. Arrange for padlocking with two locks in either "off" or "on" position.

6. All current carrying pacts shall be high conductivity copper.

7. Switching action shall be quick-make, quick-break type.

PART 3 - EXECUTION

3.1 INSTALLATION OF STARTERS

A. Standard: Install motor starters where indicated, in accordance with manufacturer' s written instructions and in conformance with NFPA 70 and NEMA standards.

B. Coordination: Coordinate starter accessories such as pushbutton switches or H-O-A

switches and auxiliary contacts with automatic control sequencing requirements.

C. Mounting: Bolt wall mounted panels to walls or mount on lightweight structural steel bolted to the wall. Mount floor supported starters on structural steel welded frames of 1-1/2-inch by 1-1/2-inch by 1/4-inch (38 mm x 38 mm x 6 mm) welded steel, two vertical posts with crossarm, and bolt to the floor. Construct feet of 6-inch by 6-inch by 3/8-inch (150 mm x 150 mm x 10 mm) thick steel plate bolted to the floor.

D. Location: Locate starters within sight of their associated motors. Where starter is not within sight of the motor, provide a heavy duty disconnect switch at the motor.

E. Large Motors: For motors 50 horsepower (37 kW) and larger, disconnect device shall be a non-automatic circuit breaker with NEMA enclosure.

F. Fuses: Install fuses in fused disconnect switches. Size fuses in conformance with NFPA 70, and UL 198B, 198C, 198D, 198E, 198F, 198G, 198H, 198L, and 198M listed.

END OF SECTION 16482

SECTION 16510 - LIGHTING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Extent of interior lighting fixture work is indicated on drawings and schedules, by requirements of this Section, and Section 16010, "Electrical Basic Requirements."

B. Types: Types of interior lighting fixtures in this Section include the following:

1. Fluorescent.
2. Incandescent.
3. High-intensity-discharge (HID).

C. Related Sections: Refer to other sections of Division 16 for the following:

1. Basic Electrical Materials and Methods.
2. Electrical Identification.
3. Wires and Cables.

D. Other Divisions: Refer to other divisions of the specification for the following:

1. Ceiling Tile.
2. Ceiling Suspension System.

1.2 QUALITY ASSURANCE

A. Manufacturers: Provide products of firms regularly engaged in the manufacture of interior lighting fixtures of types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Certified Ballast Manufacturers Association (CBM) Labels: Provide fluorescent-lamp ballasts which comply with CBM standards and carry the CBM label.

C. National Electrical Manufacturers Association (NEMA): Comply with applicable requirements of NEMA LE 4, "Recessed Luminaries, Ceiling Compatibility" pertaining to recessed luminaries.

D. National Fire Protection Association (NFPA): Comply with NFPA 70, "National Electrical Code," as applicable to construction and installation of interior building lighting fixtures and emergency lighting.

E. Provide emergency and exit marker lighting units that comply with NFPA 101, "Code for Safety to Life From Fire in Buildings and Structures," and local codes.

F. Underwriters Laboratories, Inc. (UL): Comply with UL standards pertaining to interior lighting fixtures for hazardous locations.

1. 57 Electric Lighting Fixtures

2. 542 Lampholders, Starters and Starter Holders for Fluorescent Lamps

3. 676 Underwater Lighting Fixtures

4. 844 Electric Lighting Fixtures for Use in Hazardous (Classified) Locations

5. 924 Emergency Lighting and Power Equipment

6. 1029 High-Intensity-Discharge Lamp Ballasts

7. 1570 Fluorescent Lighting Fixtures

8. 1571 Incandescent Lighting Fixtures

9. 1572 High Intensity Discharge Lighting Fixtures

G. UL: Provide interior lighting fixtures and emergency lighting units which have been UL listed and labeled.

1.3 SUBMITTALS

A. Division 1: Conform to the requirements of Division 1, Section 01003, "Submittals."

B. Product Data: Submit manufacturer's data on lighting fixtures, lamps and ballasts.

1. Include electrical ratings and photometric data with certified results of independent laboratory tests.

2. Include data on batteries and chargers of emergency lighting units.

C. Shop Drawings: Submit dimensioned drawings of lighting fixtures. Submit fixture shop drawings in booklet form with separate sheet for each fixture, assembled in order of luminare "Type" designation with proposed fixture and accessories clearly indicated on each sheet.

D. Manuals: Prior to final inspection, provide complete set of operating and maintenance manuals. Include technical data sheets and parts ordering information. Include testing and maintenance requirements and instructions for emergency lighting equipment.

E. Computer Generated Plot: Submit plot of lighting intensity at work plane height of 2 feet 6 inches (750 mm) above finished floor for typical spaces where indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (Not Used)

2.2 GENERAL

A. Lighting Fixture Requirements: Provide fixtures which meet the requirements of these specifications and the project drawings.

B. General Requirements: Provide lighting fixtures of sizes, types, and ratings indicated; complete with, but not necessarily limited to, housings, lamps, lamp holders, reflectors, ballasts, starters, wiring and batteries and battery charging devices.

1. Form fixture sheet metal housings to prevent warping and sagging. Return or clean all edges free of all burrs or sharp spots. Provide fixtures free from light leaks after installation.

2. Hinged door closure frames shall operate smoothly without binding. Fabricate frames to allow lamp installation/removal without tools. Hinge mechanism shall be designed to preclude accidental falling of hinged door closure frames during relamping operations and while secured in operating position.

3. Interior light reflecting surfaces shall have reflectance of not less than 85 percent for white surfaces, 83 percent for specular surfaces, and 75 percent for specular diffusing surfaces.

4. Provide manufacturer's standard finish applied over corrosion-resistant primer, free of streaks, runs, holidays, stains, blisters, or similar defects. Remove any fixtures showing evidence of rust at time of final inspection.

5. Light transmitting components shall be fabricated of 100 percent virgin acrylic plastic or water white, annealed, crystal glass. Minimum average thickness of lenses for fluorescent fixtures shall be 0.125-inch (3.2 mm). Fabricate frames to allow for expansion of lens without distortion or cracking. For plastic lenses, diffusers, and covers, provide high resistance to yellowing due to UV radiation.

6. Provide each fixture with lamps as indicated. Where lamps are not indicated, provide lamps as recommended by manufacturer.

7. For locations with severe environmental conditions such as damp, high temperature, or flammable vapors provide fixtures specifically labeled and listed for the particular conditions to be encountered.

2.3 FLUORESCENT LIGHTING FIXTURES

A. General: Conform to UL 1570, except for damp and wet locations conform to UL 57.

B. Fluorescent Lamps: Provide the number, type, and wattage indicated. Provide lamps conforming to American National Standards Institute (ANSI) C78.

C. Fluorescent Ballasts: Provide fluorescent ballasts conforming to UL 935, "Fluorescent-Lamp Ballasts," ANSI C82.1, "Ballasts for Fluorescent Lamps - Specifications." Provide fixtures labeled by CBM and certified by Electrical Testing Laboratories (ETL). Ballasts shall be high power factor type, unless indicated otherwise, designed to operate on the voltage system to which they are connected. Ballasts shall be Class P with sound rating "A" unless otherwise noted. Fixtures and ballasts shall be designed and constructed to limit the ballast case temperature to 90 degrees C. when installed in an ambient temperature of 40 degrees C.

1. Low Temperature Ballasts: Provide fluorescent ballasts having a minimum starting

temperature of minus 20 degrees C (-20□C) in fixtures located where ambient temperature may fall below 50 degrees F (10 degrees C).

2. Energy-Saving Electronics Ballasts: Provide energy-saving electronics fluorescent ballasts of the CBM certified full light output type, compatible for use with energy-saving lamps. Average input wattage 69 or less when operating two F32T8 lamps, 32 or less when operating one F32T8 lamp, tested in accordance with ANSI C82.2, "Fluorescent Lamp Ballasts - Methods of Measurement," methods.

D. Lamp Sockets: Comply with UL 542 and ANSI C81.20, "Electric Lamp Bases and Holders - Fluorescent Types, Specifications for."

2.4 HIGH INTENSITY DISCHARGE (HID) LIGHTING FIXTURES

A. General: Except lighting fixtures for damp and wet locations, lighting fixtures shall conform to UL 1572.

B. HID Lamps: Provide the number, type, and wattage indicated. Provide lamp type conforming to ANSI C78.

C. HID Ballasts: HID ballasts shall conform to UL 1029 and ANSI C82.4, "Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)" constant wattage autotransformer (CWA) or regulator, high power factor type, unless otherwise indicated. Ballasts shall operate on the voltage system to which they are connected. Single-lamp ballasts shall have a minimum starting temperature of minus 30 degrees C. Ballasts shall be designed for installation in a normal ambient temperature of 40 degrees C. Ballasts shall be constructed so that open circuit operation will not reduce the average life. High pressure sodium (HPS) ballasts shall have a solid-state ignitor/starter with an average life in the pulsing mode of 10,000 hours at an ignitor/starter case temperature of 90 degrees C. Average life is defined as the time after which 50 percent will have failed and 50 percent will have survived under normal conditions.

D. HID Lighting System Noise Criteria: Where indicated, provide HID lighting systems which have a corrected lighting system noise criterion (LS-NC) rating as indicated. LS-NC ratings, correction factors, and methods of determination shall be as specified in NEMA LE 2, "H-I-D Lighting System Noise Criteria (LS-NC), Ratings."

2.5 INCANDESCENT LIGHTING FIXTURES

A. General: Conform to UL 1571, except lighting fixtures for damp and wet locations shall conform to UL 57.

B. Incandescent Lamps: Provide the number, type, and wattage indicated on drawings and details.

C. Lamp Sockets: Conform to UL 496, "Edison Base Lampholders."

D. Fixture Types: Conform to Contract Drawings.

2.6 RECESSED AND FLUSH-MOUNTED FIXTURES

A. General: Provide type that can be relamped from the bottom, except as otherwise indicated.

Trim for the exposed surface of flush-mounted fixtures shall be as indicated. Provide trims, mountings, supports and adapters for type of ceiling in which mounted. Verify before ordering.

2.7 SUSPENDED FIXTURES

A. General: Provide hangers capable of supporting twice the combined weight of the adjoining fixtures and provide with swivel hangers to ensure a plumb installation. Hangers shall be cadmium-plated steel with swivel-ball tapped for the conduit size indicated. Where indicated, provide shock-absorbing type hangers which allow fixtures to swing within an angle of 20 degrees.

B. Support: Brace pendants 4 feet (1200 mm) or longer to limit swinging. Provide single-unit suspended fluorescent fixtures with twin-stem hangers.

C. Multiple-Unit or Continuous Row Fixtures: Provide multiple-unit or continuous row fluorescent fixtures with tubing or stem for wiring at one point and a tubing or rod suspension for each unit length of chassis, including one at each end. Provide rods with minimum 3/16-inch (5 mm) diameter.

2.8 EXIT SIGNS

A. General: Provide exit signs conforming to UL 924, NFPA 70 and NFPA 101.

B. Type as detailed on contract documents.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Setting and Securing: Set lighting fixtures plumb, square, and level with ceiling and walls, in alignment with adjacent lighting fixtures, and secure in accordance with manufacturers' directions and approved shop drawings. Conform to the requirements of NFPA 70.

B. Mounting: Mounting heights specified or indicated are to bottom of fixture for suspended and ceiling-mounted fixtures and to center of fixture for wall-mounted fixtures. Obtain approval of the exact mounting for lighting fixtures on the job before installation is commenced and, where applicable, after coordinating with the type, style, and pattern of the ceiling being installed.

C. Support: Recessed and semi-recessed fixtures may be supported from suspended ceiling support system ceiling tees if the ceiling system support rods or wires are provided with a minimum of four rods or wires per fixture and located not more than 6 inches (150 mm) from each corner of each fixture.

1. For round fixtures or fixtures smaller in size than the ceiling grid, provide a minimum of four rods or wires per fixture and locate at each corner of the ceiling grid in which the fixture is located.

2. Do not support fixtures by ceiling acoustical panels.

3. Where fixtures of sizes less than the ceiling grid are indicated to be centered in the acoustical panel, support such fixtures independently or with at least two 3/4-inch (19 mm) metal channels spanning and wired to the ceiling tees.

4. Provide rods or wires for lighting fixture support under this Section of the specifications.

5. Additionally, for recessed fixtures, provide support clips securely fastened to ceiling grid members, a minimum of one at or near each corner of each fixture.

D. Coordination: Coordinate with other trades as appropriate to properly interface installation of lighting fixtures with other work.

E. Grounding: Ground non-current-carrying parts of electrical equipment. Where the copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.

3.2 EXIT AND EMERGENCY LIGHTS

A. General: Wire exit lights on separate circuits. Connect exit lights to circuit breakers in the emergency panel. Wire emergency lighting units ahead of the switch to the normal lighting circuit located in the same room or area.

3.3 ADJUST AND CLEAN

A. Clean: Clean lighting fixtures of dirt and debris upon completion of installation.

B. Protection: Protect installed fixtures from damage during remainder of construction period.

3.4 FIELD QUALITY CONTROL

A. Tests: Upon completion of installation of lighting fixtures, and after building circuits have been energized, apply electrical energy to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting. Meet the requirements of Division 1 section, "Start-Up/Commissioning."

1. For normal and emergency building lighting, upon completion of the installation, conduct an operating test to show that the equipment operates in accordance with the requirements of this Section.

2. Test all wiring with an insulation testing instrument, both before and after connection of fixtures and equipment. The minimum resistance shall be 250,000 ohms.

3. Conduct ground resistance tests on each fixture. The maximum resistance to ground of grounded equipment shall not exceed 25 ohms.

4. To demonstrate all functions and protective operations of the exit and emergency lighting system, simulate malfunctions to verify proper functioning. Provide instruments as required to make positive observation of test results. Include the following in tests:

a. Duration of supply.

b. Low battery voltage shut down.

c. Normal transfer to battery source and retransfer to normal.

d. Low supply voltage transfer.

B. Replacement Lamps: At the time of substantial completion and prior to field tests, replace lamps in interior lighting fixtures which are observed to be noticeably dimmed after Contractor's use and testing. Furnish stock or replacement lamps amounting to 15 percent (but not less than one lamp in each case) of each type and size lamp used in each type fixture. Deliver replacement stock as directed.

1. Refer to Division 1 sections for the replacement/restoration of lamps in interior lighting fixtures, and where used, the temporary lighting prior to time of substantial completion.

END OF SECTION 16510

SECTION 16611 – UNINTERRUPTIBLE POWER SUPPLY SYSTEMS

PART 1 - GENERAL

1.1 THE SYSTEM

This specification describes a three phase, on-line, solid state Uninterruptible Power System here after referred to as the UPS. The UPS shall operate in conjunction with the existing building electrical system to provide power conditioning, back-up power protection and distribution for electronic equipment loads. The system shall consist of a solid state inverter, rectifier/battery charger, a 100% rated for continuous duty static switch, an internal maintenance bypass switch and battery plant as described herein.

PART 2 – RATINGS:

2.1 RATINGS INFORMATION:

The UPS is available in the following sizes: 50 kVA/40 KW

2.2 INPUT REQUIREMENTS:

A. Voltage: 480 VAC, 3 phase, 3 wire plus ground ± 15%.

B. Input Frequency: 60 Hz ± 10%

C. Input Current: 96 amperes.

D. Input Power Factor: Up to .98 lagging

E. Input Current Total Harmonic Distortion:

An input filter shall be provided to limit input current harmonic distortion (THD) to less than 10% THD and improve input power factor to .98. The input filter shall be mounted inside the UPS cabinet.

F. Power Walk-in: 0 to 100% over a 10 second period.

G. Magnetizing Inrush Current: Less than nominal input current for less than one cycle.

2.3 OUTPUT CHARACTERISTICS:

A. Voltage: 3 ph, 4 wire plus Gnd (Output voltage adjustable ± 3%)

B. Voltage Regulation:

± 1.0% for 100% balanced load
± 1.75% for 50% unbalanced load
± 2.5% for 100% unbalanced load

C. Voltage Transient Response:

± 6% for 100% slap load change

± 3% for 50% step load change
± 1% for loss or return of AC input power
± 1% for manual transfer at full load

D. Voltage Recovery Time: Return to within 1% of nominal value within 16.67 milliseconds.

E. Phase Angle Displacement:

120 º ± 1º for balanced load
120° ± 3° for 100% unbalanced load

F. Linear Load Capability: Output voltage total harmonic distortion (THD) shall be maximum 2%
and 1% for any single harmonic order when the UPS is connected to 100% linear loads.

G. Non-linear Load Capability: Output voltage total harmonic distortion shall be less than 3.5% when connected to a 100% non-linear load with a crest factor not to exceed 3.5.

H. Frequency: 60 Hz ± 2% synchronized with bypass (selectable in 1%, 1.5%, 3%, 4% increments). 60 Hz ± 0.1% free running.

I. Slew Rate: Set at 1 Hz/second maximum (selectable up to 2.0 Hz).

J. Power Factor; 0.8 at the rated volt-amperes (VA).

K. Overload Capability:

110% of rated load for 10 minutes.
130% of rated load for 1 minute.
150% of rated load for 10 seconds.

L. Efficiency:
The UPS efficiency (AC to AC) with nominal input voltage and battery full charged under linear
or non-linear loading shall be: 94% from 25% to 100% load.

2.4 <u>DC Bus</u>

A. VDC minimum: 361 VDC at 25° C, 77° F
VDC nominal: 432 VDC at 25° C, 77° F
VDC Float: 490 VDC at 25° C, 77° F

B. Current: ADC maximum at cutoff voltage: 197 amperes.

C. Nominal DC Bus:

Temperature Rating: 77° F, 25° C

Number of Cells 216 Cells

D. AC Ripple: < 1% of DC voltage

E. Battery Protection:

1. Temperature Compensation: The UPS will include provisions for automatic temperature compensation charging during the charging cycle. Between 30° and 40º C ambient temperature inside the battery compartment, the charger voltage will phase back to prevent over-charging of the battery in a high temperature condition. Above 40° C the UPS will stop charging the battery and alarm on a high battery temperature.

2. Deep Cycle Protection: The battery cutoff voltage will be automatically raised during long discharges to extend battery life.

3. Long Outage Protection: The UPS will remain connected to the battery and automatically restart the charger and UPS for outages less than 3 times the full load battery time plus two hours. For longer outages, the UPS will shut-down to protect the battery and require a manual restart.

4. Battery shall be sealed, lead and in (1) matching cabinet sized to support 80 KVA/64 KW for 28 minutes.

2.5 Environmental Conditions:

A. Ambient Temperature:

Operating: 0° to 30° C
Up to 40° C for 8 hours

Non-Operating: -25° to + 70° C

B. Relative humidity (operating and storage): 0 to 95° non-condensation

C. Barometric Pressure:

Operating: Up to 3000 feet above seal level (up to 6000 feet with ambient temperature less than 28° C).

Non-Operating: Up to 36,000 feet above sea level

D. Acoustical Noise: 65 dB “A” weighting at 3 feet.

PART 3 - EXECUTION

3.1 SYSTEM DESCRIPTION AND OPERATION:

The UPS shall be designed to operate as an on-line reverse transfer system in the following modes:

A. Normal:

The inverter shall continuously supply power to the critical load. The rectifier/battery charger shall drive power from the utility AC source and supply DC power to the inverter while simultaneously float charging the battery.

B. Emergency:

Upon failure of the utility AC power source, the critical load shall be supplied by the inverter, which, without any switching, shall obtain its power from the battery.

C. Recharge:

Upon restoration of the utility AC powers source (prior to complete battery discharge), the rectifier/battery charger shall power the inverter and simultaneously recharge the battery.

D. Bypass Mode:

The static bypass transfer switch shall be used to transfer the load to the bypass without interruption to the critical power load. This shall be accomplished by turning the inverter off. Automatic re-transfer of forward transfer of the load shall be accomplished by turning the inverter on.

E. Maintenance Bypass/Test Mode (External)

A manual make before break wrap around, three circuit breaker maintenance bypass switch shall be provided to isolate the UPS inverter output and static bypass transfer switch for maintenance. This shall allow the UPS to be tested or repaired without affecting load operation.

3.2 FUNCTIONAL DESCRIPTION:

A. Rectifier/Battery Charger:

A six (6) pole, solid-state rectifier shall convert the incoming AC power to regulated DC voltage, which shall be subsequently filtered to provide power for the battery charging functions. The rectifier/battery charger shall have sufficient capacity to support recharging of the battery. The rectifier/battery charger assembly shall be constructed of modular design to facilitate maintenance.

1. Input Protection:

The rectifier/battery charger shall be protected by input fuses.

B. Inverter:

The UPS output shall be derived from a Pulse Width Modulated (PWM) IGBT inverter design. The inverter shall be capable of providing the specified precise output power characteristics (specified in paragraph 2.3) while operating over the battery voltage range. The inverter assembly shall be constructed of modular rack out assemblies to facilitate maintenance.

C. Static Bypass:

The static bypass transfer switch shall be solid-state, rated for continuous duty and shall operate under the following conditions:

1. Uninterrupted Transfer:

The static bypass transfer switch shall automatically cause the bypass source to assume the

critical load without interruption after the logic senses on one of the following conditions:

a. Battery protection period expired and bypass available.
b. Inverter failure.

2. Interrupted Transfer:

If the bypass source is beyond the conditions stated below, interrupted transfer shall be (not less than 500 msec, in duration) made upon detection of a fault condition.

a. Bypass voltage greater than + 10%, - 10% from the UPS rated output voltage.
b. Bypass frequency greater than ± 2 Hz from the UPS rated output frequency.

3. Automatic Uninterrupted Forward Transfer:

The static bypass transfer switch shall automatically forward transfer, without interruption, after the UPS inverter is turned "ON", after an instantaneous overload-induced reverse transfer has occurred and the load current returns to less than the units 100% rating.

4. Manual Transfer:

A manual static transfer shall be initiated from the System Status and Control Panel by turning the
UPS inverter off.

5. Overload Ratings:

The static bypass transfer switch shall have the following overload characteristics:

a. 1000% of UPS output rating for 0.016 seconds (one cycle)
b. 130% of UPS output rating for 1 minute
c. 110% of UPS output rating for 10 minutes
d. 1000% of UPS rating for 1 cycle

D. Input Filter

An input filter shall be included to limit input current harmonic distortion to less than 10%. Input Isolation Transformer.

E. Microprocessor Controlled Logic:

The full UPS operation shall be provided through the use of microprocessor controlled logic.

All operation and parameters are firm ware controlled, thus eliminating the need for manual adjustments or potentiometers. The logic shall include a self-test and diagnostic circuitry such that a fault can be isolated down to the printed circuit assembly or plug-in power assembly level. Every printed circuit assembly or plug-in power assembly shall be monitored. Diagnostics shall be performed via a PC through the local diagnostics port on the unit, or via a modem through the RS232 communication port.

F. Standard Communication Panel:

The UPS will include a standard easy to use communication panel. Included will be visual and audible indicators for UPS online, UPS fault, Ups on battery, and UPS off line. The UPS communication panel will include fail safe UPS "ON" and UPS "OFF" push buttons that will permit the user to safely command the UPS on or off without risk of load loss. Shall be used to silence the audible alarm. If a new alarm is sensed after the original alarm has been silenced, it shall re-activate the audible alarm.

1. Emergency Power Off (EPO)

When EPO is pressed, it shall cause the AC input contactor bypass input contactor and battery circuit breakers to open, thereby shutting down the UPS and the load. The EPO function shall be capable of being initiated by an externally provided N/C isolated dry contact (REPO).

G. Mechanical Design/Cable Entry

1. Enclosure:

The UPS shall be housed in a free standing enclosure with dead front construction. The UPS

can accommodate both bottom and top entry cables. The dimensions and weight of the UPS

shall be: 66" H x 32" W x 33"D. Bypass cabinet : 26.5" is x 33" D x 66" H. Battery Cabinet: 48" W x 33" D x 66" H.

2. Ventilation:

The UPS shall be designed for forced air cooling. Air inlets shall be provided from the front bottom of the UPS enclosure. Air exhaust shall be from the top rear portion of the unit. Air filters shall be provided as standard.

3. Full load heat rejection is as follows: 13, 942 BTU/Hr.

3.3 Communication Feature:

A. Standard Communication Panel:

The UPS will include a standard easy to use communication panel. Included will be both visual LCS and audible indicators. The UPS communication panel will include fail safe UPS "ON" and UPS "OFF" pushbuttons that will permit the user to safely command the UPS without risk of load loss. A local Emergency Power Off (EPO) will be provided to turn the UPS off and isolate it from incoming and battery power. An alphanumeric display will be included for indication of UPS alarms and metering information advanced operational features.

The display system operations and parameters.

1. System Parameters Monitored

The visual display will show the following system parameters based on true RMS metering:

- Input voltage

- Bypass voltage
- Bypass input frequency
- UPS output voltage (3 phase simultaneously)
- UPS output current/phase (3 phase simultaneously)
- UPS output frequency
- UPS output % load
- UPS output KVA
- DC voltage
- Time remaining on battery and available battery time.

B. DB-9 Connector: One DB-9 connector will be provided for field diagnostics.

C. Dry Contacts:

Four (4) isolated dry contacts shall be available for external connection on a DB-15 connector provided on the rear panel. Contacts available include:

- UPS on Line
- Load on Bypass
- UPS on Battery
- UPS Battery Low

The contacts will be normally open and will change state to indicate the operating status. The contacts will be rated 100 milliamp at 24 VDC.

PART 4 – ACCESSORIES

4.1 OPTIONAL TERMS:

A. Battery Disconnect:

A wall mounted NEMA 1 enclosed 225 Ampere rated disconnect shall be provided. It will be equipped with a shunt trip circuit and auxiliary contacts for switch position.

B. Two communication slots shall be provided for customer use. The communication port options are listed as follows:

1. RS232 (U-Talk). Active RS 232 with U-talk protocol for remote monitoring and file server shut-down for most popular file servers and operating systems shall be provided. Includes one communication board, software and communication cable. Requires one communication slot.

- UPS on Line
- Load on Bypass
- UPS on battery
- UPS Battery Low
- Summary Alarm

2. Remote Status Panel

A NEMA 1 enclosed wall mounted status panel with indicator lights and audible alarm for

UPS on line, UPS on battery, UPS summary alarm, battery shut down imminent, and UPS on bypass is provided.

PART 5 – STANDARDS

5.1 APPLICABLE STANDARDS AND AGENCY APPROVAL:

The UPS shall meet the requirements of the following standards:

A. UL listed under 1778, Standards for Uninterruptible Power Supply Equipment.

B. UL Canada (CUL)

C. FCC rules and regulations of Part 15, Subpart J, Class A

D. IEEE 587-1980/ANSI C62.41 1980 Standards for Surge Withstand Ability.

E. The UPS shall be designed in accordance with the applicable sections of the documents published by:

- National Fire Protection Association (NFPA)/National Electric Code (NEC)
- National Electrical Manufacturer's Association (NEMA)
- Occupational Safety & Health Administration (OSHA)

PART 6 – MANUFACTURERS

6.1 APPROVED MANUFACTURER :

The specified equipment shall be manufactured by MGE UPS Systems, Inc.

6.2 DOCUMENTATION:

The manufacturer shall furnish the owner an instruction manual covering the installation, operation and maintenance of the MGE UPS batteries.

6.3 WARRANTY:

The UPS shall be covered by a full parts and labor warranty from the manufacturer. The warranty period shall be for twelve (12) months from date of installation or acceptance by customer or eighteen (18) months from date of shipment from the manufacturer, whichever occurs first.

SECTION 16670 - LIGHTNING PROTECTION SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Remove existing lightning protection and provide new lightening protection system work required in this Section and Section 16010, "Electrical Basic Requirements."

1.2 QUALITY ASSURANCE

A. Manufacturer: All components of the lightning protection system shall be UL listed and the product of a manufacturer regularly engaged in the production of lightning protection equipment.

B. Specialty Subcontractor: Lightning protection systems shall be installed by a specialist with at least 3 years of successful installation experience on projects with lightning protection work similar to that required for this Contract.

1. Specialty subcontractor shall be a member of the Lightning Protection Institute (LPI).

C. Lightning Protection Institute (LPI): Conform to the following LPI standards:

1. 175 Lightning Protection Installation Standard.
2. 176 Lightning Protection System Material and Component Standard.
3. 177 Inspection Guide for LPI Certified Systems.

D. Conform to the requirements of the National Fire Protection Association (NFPA) 78, "Lightning Protection Code."

E. Underwriters Laboratories, Inc. (UL): Conform to the following UL standards:

1. 96 Lightning Protection Components.
2. 96A Installation Requirements for Lightning Protection Systems.

1.3 SUBMITTALS

A. Division 1: Conform to the requirements of Division 1, Section 01003, "Submittals."

B. Certification: Provide certification for the lightning protection system as follows:

1. The Contractor shall provide a certification, signed by an officer of the corporation, that lightning protection systems will be installed in strict compliance with the Contract documents, the drawings and the reference standards included herein.

2. The specialty subcontractor shall certify that materials, products, and installation procedures will conform strictly with the referenced standards and this Section.

C. Shop Drawings: Submit shop drawings for the lightning protection systems.

1. Draw on sheet sizes the same as the Contract Drawings.
2. Draw to a scale of not less than 1/8-inch to one foot (1:100).
3. Provide details of mounting, isolating, anchoring, and routing the lightning protection system through the proposed construction work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (Not Used)

2.2 DISSIMILAR METALS

A. General: No combination of materials shall be used that form an electrolytic couple of such a nature that corrosion is accelerated in the presence of moisture. If dissimilar materials are used, provide waterproof seals so that moisture is permanently excluded from the junction of such metals.

2.3 AIR TERMINALS

A. Requirements: Provide air terminals of 1/2-inch (13 mm) diameter nickel-tipped solid copper at locations as required by NFPA.

1. Air terminals shall not be less than 10-inches (250 mm) high, tapered to a point.
2. The ground wire shall be fastened by threaded bolts to a bronze connector with a male threaded stud on which the female threaded air terminal shaft shall be mounted.
3. Terminal shall be securely attached to the building.

2.4 CONDUCTORS

A. General: Provide conductors of 98 percent electrical grade copper.

1. The weight of copper conductors shall not be less than 375 pounds per thousand feet (56 g/m).
2. The size of any wire in the cable shall not be less than No. 17 MS gauge (1.4 mm).
3. Copper tube or solid-section conductors of copper shall weigh not less than 187.5 pounds per thousand feet (26 g/m) with a tube wall not less than No. 20 MS gauge (0.9 mm).
4. The thickness of and copper ribbon conductor or strip shall be not less than No. 16 gauge (1.6 mm) nor less than 1-inch (25 mm) in width.

B. Conductor Protection: If mechanical hazard is involved, the conductor size shall be increased to compensate for potential damage or suitable protection shall be provided. Protection may be wood molding or tubing specifically designed to protect the conductor or other nonmagnetic material.

2.5 GROUND RODS

A. General: Provide ground rods not less than 3/4-inch (19 mm) in diameter by 24 feet long (300 mm) long.

1. Rods shall be copperclad steel, solid copper or stainless steel.
2. Provide solid bronze 4-inch (100 mm) long ground rod clamps for connecting conductors to the ground rod.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall conform to the requirements of NFPA 70, "National Electrical Code," Article 250, NFPA 78, and UL 96. The work shall be accomplished by personnel skilled in this type of work.

1. Avoid sharp bends or narrow loops in conductors.

3.2 TESTING

A. General: Upon completion of the lightning protection work, test the resistance to ground. Resistance to ground shall not exceed 5 ohms.

1. Should ground resistance exceed 5 ohms, drill 1-inch (25 mm) diameter holes approximately 2 feet (600 mm) distance from the ground rod by 10 feet (3 m) deep minimum and fill each hole with a mixture of 90 percent magnesium and 10 percent copper sulfate and then soak with water. Retest the system.

END OF SECTION 16670

SECTION 16760 - VOICE AND DATA COMMUNICATIONS INFRASTRUCTURE

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

1.2 SUMMARY

A. This section includes conduits, tray, junction boxes, connecting devices, installation, labeling and documentation for the communications infrastructure.

B. Related Sections:

1.3 DEFINITIONS

A. EMI: Electromagnetic Interference

B. IDC: Insulation Displacement Connector

C. LAN: Local Area Network

1.4 SUBMITTALS

A. Product Data: Include data on features, ratings, and performance for each component specified.

B. Shop Drawings: Include dimensioned plan and elevation views of each individual component. Show equipment assemblies, method of field assembly, workspace requirements, and access for cable connections.

C. System labeling schedules, including electronic copy of labeling schedules, as specified in Part Three, in software and format to the Contracting Officer as specified by the NIMA Enterprise Network Engineering Group.

1. Comm. closet/conduit/tray/junction box diagrams. Show typical comm. closet schematics. Show all the information that is maintained in the NIMA AutoCAD drawing system. To include:

   a. Comm. closet floor plan.
   b. Rack locations
   c. Tray paths and size
   d. Conduit paths
   e. Junction boxes and conduit connection points
   f. Rack and comm. closet labeling.
   g. Risers with conduit locations size and number.
   h. Grounding information.
   i. Distinguish the black infrastructure from the red infrastructure.
   j. Maintain the same standard and format as the NIMA AutoCAD drawing system.

D. Samples: Submit samples of following items to the COR for review and acceptance by the NIMA Enterprise Network Engineering Group:

1. Samples of all different types of communications labels to include floor mounted outlet box labels, outlet box labels, communications rack labels and grounding system labels.

2. A completed red cabling protective distribution system (PDS) . This submittal shall include conduits, couplers, Hoffman boxes/troughs, comm. outlet boxes, red/black isolation, and red grounding.

3. A completed red and a completed black floor mounted outlet box assembly. This system shall include the faceplates, the plenum rated ¾ inch liquid tight flexible conduit connections to the outlet box/tray/junction box. Each box system shall also include all of the appropriately placed labeling.

4. A completed red and a completed black wall outlet box assembly with modules installed with in the faceplates. This assembly shall include labels.

5. A complete As built MS AutoCAD communications infrastructure floor drawing posted in each floors communications closet display case.

6. No communication work shall begin until the NIMA Enterprise Network Engineering Group reviews and signs off on the relevant submittals.

E. Product Certificates: For each type of cable connector, junction boxes, cable tray and terminal equipment, signed by product manufacturer.

F. Qualification Data: For installer Testing agency

G. Field Quality Control Test Reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: System installer must have on staff a registered communication distribution designer certified by Building Industry Consulting Service International.

B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the testing indicated, that is a member company of the International Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

C. At the 25%, 50%, 75% and 100% communications installation completion point, the construction contractor shall conduct a formal inspection of the completed work with the COR and the NIMA Communications Engineering Group. A formal letter from the

NIMA Communications Engineering Group shall be sent to the Contract Officer. This letter shall document the results of the inspection and shall become a permanent part of the NIMA contract file.

D. Source Limitations:

1. Obtain all products through one source from a single manufacturer:
   a. N/A

2. Obtain the following products as Government furnished products:

   a. Bud Economizer Rack ER-16626RB with 19-inch panel width. A second set of mounting rails shall be purchased and installed. The Bud part number is PMR-9454.
   b. Security labels for conduit and cable tray
   c. Wiremold AC series raised floor mounted walker style boxes.
   d. For comm. closet 1TC1, 1TC2, 2TC1, 2TC2, 3TC1 and 3CT2 Geist VRTC140-1027 TL power strips (Two per Rack).

3. Obtain the following products through one source from a single manufacturer and specify name brand or equal:
   a. N/A

4. Obtain the following products through one source from a single manufacturer and specify name brand:
   a. N/A

E. Electrical Components, Devices, and Accessories; Listed and labeled as defined in NFPA 70, article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.

F. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate layout and installation of comm. infrastructure with the NIMA Enterprise Network Engineering Group.

1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and the NIMA Enterprise Network Engineering Group to exchange information and agree on details of equipment arrangements and installation interfaces.

2. Record agreements reached in meetings and distribute to other participants.

3. Adjust arrangements and locations of distribution frames/racks and wire mold AC series floor mounted comm. boxes and wiring closets to accommodate and optimize arrangement and space requirements of the NIMA comm. team.

4. Adjust arrangements and locations of office area wiring communications boxes (floor, wall, and furniture mounted) and comm. outlet plates to optimize availability, security, reliability, safety and space requirements of the communications and computer equipment.

1.7 EXTRA MATERIALS

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

1. N/A

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

B. Features of materials and equipment so they form an integrated system. Match components and interconnections for optimum future performance.

C. Comm. closet/riser system /horizontal infrastructure construction specifications are critical and must conform to strict red/black security requirements, for example NACSIM 5203 & NSTISSAM TEMPEST/2-95.

D. The red communications system must be isolated from all grounds with isolators on all of the connection points. This red infrastructure system shall not make metal-to-metal contact with non-red objects. This requirement included isolation from all re-bars imbedded in the concrete building structure.

2.2 MOUNTING ELEMENTS

A. Cable Trays: The cable trays shall be of the welded galvanized steel, basket tray type and consist of 2” X 4” steel wire mesh The channel depth of the tray shall be 2 inches deep. See design drawing for width.

1. The tray system will be made electro–plate zinc galvanizing steel wire and shall be UL classified as an equipment grounding conductor.
2. The cable trays shall be of the cope CAT-Tray type.
3. All cable tray bends shall be of the long radius bend type.

B. Raceways and Boxes:

1. All junctions boxes shall be:
   a. Hoffman type boxes.

b. Hinged cover
c. Pad lockable
d. NEMA Type 1
e. See design drawing for size.

2. Access to the junction boxes and the raceways shall not be obstructed.

3. All of the raceways shall be:
   a. Wiremold company type.
   b. Hinged cover.
   c. Pad lockable
   d. See design drawing for size.

C. BackBoards: ¾ inch (19mm), interior grade, fire retardant-treated plywood. All of the backboards shall be painted with fire retardant paint of a similar color to the wall paint.

D. The SI construction contractor shall provide and install a 36”X36” display case in each the comm. closets and comm. room. The display case shall be keyed to the NIMA comm. closet display key and have a cork backing with a clear Plexiglas, full view, hinged, lockable door. The construction contractor shall post the NIMA approved FB as-built communications infrastructure drawing in each of the display cases.

E. Conduits: See 3.6 for additional requirements.

1. All conduits shall be coupled with compression type fittings.

2. 90-degree elbows and L’s are not permitted. The contractor shall use two 45-degree elbows on communications conduit runs

3. All conduit termination/ending points shall end with a plastic bushing. Red bushing shall be used on the red conduit system and black bushings shall be used on the black conduit system. This requirement includes the conduit ending points within the furniture partition panels.

4. When conduits cross from one SCIF area to another SCIF area, the coupled area shall be coated with epoxy prior to tightening the fittings into place.

5. All flexible metal tubing (Flex) shall have a plenum rated insulated outer coating. Each run of flexible conduit cannot exceed fifteen (15) feet in over all length

F. Distribution Racks: Freestanding, modular-steel units designed for telecommunications support and coordinated with dimensions of units supported. All racks shall be completely installed.

1. Bolt adjoining racks together.
2. Anchor racks to floor.

3. Conduit and power shall enter only at the rear top or rear bottom of the racks. Raised flooring dependent.

4. In raised floor areas, cut a 12-inch by 12-inch hole in flooring under each rack.

5. Removal of any shipping brackets, Install door bumpers, locks, rails, shelves drawers, trim power strips and other items needed to complete the rack assembly and installation. Two sets of keys for each lock shall be given to the COR.

6. Access to the racks or the equipment in the racks shall not be obstructed.

7. Give equipment-mounting screws to COR.

8. Install 2 power strips in each rack. Label each power strip with the circuit breaker number and circuit breaker panel number.

9. For COMM. CLOSETS 1TC1, 1TC2, 2TC1, 2TC2, 3TC1 and 3TC2: (BUD Economizer Rack # ER-16626RB).

10. Install an additional set of rail for each rack.

11. Approximate Module Dimensions: 84 Inches (2,130-mm) high by 22-inches (560-mm) wide by 30 ¾ Inches deep.

12. Finish: Baked-polyester powder coat (Royal Blue).

13. Be designed to mount electronic equipment with 19" panels.

G. Raised flooring and floor mounted communications boxes:

1. The raised flooring shall be grounded to the building safety ground, not the red grounding system.

2. The black Walker box shall be grounded to the building safe grounding system.

3. The red Walker box shall be grounded to the red grounding system.

4. The Walker Box connection system shall be approved by the NIMA Communications Engineering Group in writing before it is installed. Each Walker box shall be connected to the closest Hoffman box with plenum rated liquid-tight flexible conduit. The flexible conduit run shall be no longer than15 feet. Each box shall be located, in an out of the way area and under the workstation cubical desktop. The box opening shall be away from the person's feet and toward the pattitioning panel. When installing each Wiremold Company, Walker Style, AC series, floor mounted comm. box, the construction contractor shall leave enough slack in the power and comm. cables to relocate the box to an area identified by the Government. After all of the office furniture has been placed in its' permanent position, the construction contractor shall survey the location of each floor mounted comm. box with the NIMA Communications Engineering Group. The construction contractor shall relocate each raised floor mounted comm. boxes to a location acceptable to the NIMA Communications

Engineering Group. Install the comm. box covers. Glue a piece of carpet in to the comm. box cover that matches the floor carpet.

H. Wall Outlets:

1. RED--- Three flush dual fiber-optic MTRJ track jack module, one SC track jack module and One RJ-45 track jack module connector assemblies mounted in two-gang faceplate.

2. Black One ST track jack module and one RJ-45trackjack module connector assemblies mounted in two-gang faceplate.

3. Faceplate: High impact plastic; color as selected by Contracting Officer's Representative.

4. Mounting: Flush, unless otherwise indicated.

Legend: Factory labeled, fiber-optic connectors "Data" and RJ-45 jacks "Voice", by engraving.

2.3 IDENTIFACTION PRODUCTS

A. Comply with Cable Labels: Bradley label maker model ID ProPlus, with cable labels WML-311-292, 1-inch x 1.25-inches. All hardware shall be labeled in accordance with ANSI/TIA/EIA 606 "*Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.*"

PART 3 – EXECUTION

3.1 EXAMINATON

A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. At the completion of the installation, a pull line shall be installed in communications tray, chases, risers, ducts, and conduits.

B. Before the final Government inspection, the construction shall vacuum clean the comm. closets and under all of raised flooring. All of the racks and junction boxes shall be vacuumed cleaned inside and out. This cleaning shall include the top of the racks and the top of the junctions boxes.

3.3 GROUNDING

A. Comply with "Grounding and Bonding"

B. Signal Ground Terminal: Locate in each equipment room and wiring closets; isolate from power system and equipment grounding. Each comm. closet shall have a red grounding buss and a black grounding bus.

C. Main comm. closet signal Ground Bus: Mount on wall of main equipment room with standoff insulators.

D. The red conduit/tray/JB system shall be connected to the red grounding system.

E. The black conduit/tray/JB system shall be connected to the building's safety grounding system.

F. Refer to 3.6 for more grounding and bonding requirements.

G. Each grounding subsystem has a separate and distinct function as described in MIL-HDBK-419.

H. Standards for grounding and bonding are provided in MIL-STD-188-124.

3.4 INSTALLATION IN EQUIPMENT ROOMS AND WIRING CLOSETS

A. Install 4’ x 8’x ½” plywood backboards in each black communication communications closet, on one wall identified in the design-drawing package. Center the plywood on the wall. Paint plywood with paint similar to the wall. Use two coats. See design drawing for more details.

C. The contractor shall install 5 racks in each comm. closet.

D. All comm.. closet and server farm equipment racks and server power outlets shall be attached to the UPS with emergency power backup.

3.5 INSTALLATION STANDARDS

A. Comply with requirements in National Electric Code, TIA/EIA 568B, TIA/EIA 598-B, TIA/EIA 569A, TIA/EIA TSB-72, TIA/EIA 526.7, TIA/EIA 526.14A, TIA/EIA 607, TIA/EIA 758, MIL-STD-188-124, MIL-HDBK-419, BICSI standards and NSTISSAM TEMPEST/2-95. All addendums to the above documents shall also be followed. When appiable, Security requirement in NSTISSAM TEMPEST/2-95superceed TIA/EIA 607.

B. Security Standards: Consult the above security manuals for additional security requirements.

1. At least 1-meter separation shall be maintained between the red racks and the black racks.
2. The Government provided security labels shall be attached to all communications cable tray, ducts conduits and junction boxes. These labels shall be spaced at a distance of no greater than 1.5 meters.

3. A red and a black grounding plate shall be installed in each comm. closet. The red grounding plate will be attached to the building's red grounding system. The black grounding plate will be attached to the building's safety grounding system.

A grounding buss, with at least 5 connection points, shall be installed in each comm. rack. The buss in each red rack will be attached to the red grounding plate. The buss in each black rack will be attached to the black grounding plate.

4. The red conduit/tray/duct/riser system must be attached to the red grounding system.

5. The black conduit/duct/tray/riser system must be attached to the building safety grounding system.

6. The red communications system must be isolated from all grounds with isolators on all of the connection points. This riser system must not make metal-to-metal contact with non-red objects. This requirement-included isolation from all rebar imbedded in the concrete building structure. The requirement includes all of the red communication infrastructure system from the metal outlet/conduit mounted on the wall or within each workstation partition panel to the point where the communications exits the building.

7. Glastic Inc. type standoff insulators shall be coupled to the threaded rod between the floor anchor and the strut. The standoff insulator shall be kept as close to the tray as possible. These insulators will isolate the red tray system from grounded rebar in the concrete and grounds touching threaded rod.

3.6 IDENTIFICATION

A. In addition to requirements in this Article, comply with applicable requirements in “Basic Electrical Materials and Methods” and TIA/EIA-606.

B. Distribution Racks and Frames: Label each rack.

C. Exposed conduit, trays and wire troughs: Label each conduit, trays and wire troughs at intervals not exceeding 1.5 meters.

D. Infrastructure drawing: Install in each communication closet a display case that contains the Auto-CAD floor drawing that has been as built updated. This as-built drawing shall include: the building floor plans, labels for telecommunications closets, all the floor mounted outlet boxes, wall outlet boxes, and furniture mounted outlet boxes properly located and identified with labels; also all of the installed communication tray conduits, riser tray and communications closet/rack layouts marked with rack/position numbers. The drawing format and content shall be inspected and approved through the COR and by the NIMA Enterprise Network Communications Group. Provide electronic copies to the NIMA Comm. Engineering Group though the Contracting Officer.

END OF SECTION

SECTION 16856 - ELECTRIC HEATING CABLES

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 heating cables for the following applications:

1. Snow melting.

1.3 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product data for each type of heating cable and for each accessory specified. Include manufacturer's technical product data and installation instructions for electric heating cables.

C. Coordination drawings, including floor plans and sections drawn accurately to scale. Show heating cable layout and relationships between components and adjacent structural and mechanical elements. Indicate and certify field measurements. Submit with shop drawings.

D. Wiring diagrams for electric heating cables showing layout and connections. Include requirements for proper spacing between cables and show connections to electrical power feeders.

E. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

F. Field test reports from a qualified independent inspecting and testing agency indicating and interpreting test results relative to compliance with performance requirements of electric heating cables.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer to install heating cables.

B. Manufacturer Qualifications: Firm experienced in manufacturing heating cables similar to those indicated for this Project and that have a record of successful in-service performance.

C. Comply with NFPA 70 "National Electrical Code" for components and installation.

D. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

E. Single-Source Responsibility: Obtain heating cables and accessories from one source and by a single manufacturer.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions by field measurements. Verify clearances and locate obstructions.

B. Coordinate layout and installation of heating cables.

1. Coordinate with reinforcement and concrete placement.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering heating cables and accessories that may be incorporated in the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide heating cables and accessories by one of the following:

1. Infloor Heating Systems.
2. Pyrotenax USA Inc.
3. Raychem Corporation; Chemelex Div.
4. Thermon Manufacturing Co.

2.2 SNOW MELTING HEATING CABLES

A. Self-regulating, electric, radiant heating cables suitable for embedding in floor materials as indicated.

1. Temperature, wattage, and voltage ratings as indicated.
2. Pair of parallel 14 AWG nickel-coated-copper bus wires are embedded in parallel in a self-regulating polymer core, which varies power output in response to temperature along its length.
3. Cable suitable for crossing over itself without overheating.

4. Cable cover fabricated of cross-linked, modified, polyolefin dielectric jacket and tinned-copper braid, and 70-mil-thick polyolefin outer jacket.

5. The heating cable shall be of parallel circuit construction to allow the cable to be spliced if it is inadvertently cut during or after construction.
6. The heating cable shall operate on 277 volts.
7. The system shall be controlled by an automatic snow sensor controller which senses recipitation

and temperature to energize cable circuit under conditions likely indicating snow. Unit suitable for mounting above grade.

8. The heating cable power connection and end seal terminations shall be made in a junction box.
9. Each circuit shall be protected by a 30-mA ground-fault protection device.

2.3 ACCESSORIES

A. Cable installation accessories include tapes, cable ties, warning labels, end seals and splices, and installation clips for the application indicated and for a complete system.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces and substrates to receive heating cables for compliance with requirements for installation tolerances and other conditions affecting performance of the heating cables. Do not proceed with installation until unsatisfactory conditions have been corrected.

1. Ensure surfaces in contact with electric heating cables are free of burrs and sharp protrusions.
2. Ensure surfaces and substrates are plumb and level.

B. Test cables for electrical continuity before installing.

C. Test cables for insulation resistance before installing.

3.2 INSTALLATION

A. Install heating cables and accessories as indicated, according to manufacturer's written instructions, rough-in drawings, the original design, and referenced standards.

B. Cut cable to length required.

C. Do not install heater-to-cold lead connections in concrete.

D. Avoid crossing expansion, construction, or control joints with heating cables. Where indicated or required, provide sufficient slack conductor in an appropriately arranged expansion loop.

E. Connect heating cables and other components to wiring systems and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to

equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL 486A.

F. Do not energize cables embedded in concrete, until they are cured, except for brief testing.

G. The heating cable shall be installed only in concrete pavement. The pavement shall be reinforced with rebar or wire mesh and the reinforcing supported such that the location of the reinforcing and the attached heating cable is not disturbed during the concrete placement. The rebar shall be placed at the heating-cable depth whenever possible.

H. The heating cable shall be protected from where it leaves the pavement to the junction box by installing the cable in 1 inch galvanized rigid steel conduit. Use one conduit for each heating cable.

I. The power connection and end seal junction box shall be mounted above grade. The junction box shall be installed so that water cannot enter it.

J. Heating cable repairs and splices shall be made using a splice kit provided by the manufacturer and specifically approved for the purpose.

3.3 FIELD QUALITY CONTROL

A. Test installed electric heating cables after installation. Perform tests prior to application of coverings, such as insulation, plaster, or concrete.

1. Test cables for electrical continuity before energizing.
2. Test cables for insulation resistance before energizing. Remove cables if measured resistance is less than 10 megohms to ground.
3. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.

B. Repeat tests for continuity, insulation resistance, and input power after applying concrete.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.

B. Review data in the operation and maintenance manual. Refer to Division 1 Section "Project Closeout."

3.5 PROTECTION

A. Provide final protection and maintain conditions in a manner acceptable to Manufacturer and Installer to ensure that installed electric heating cables, including leads, are not damaged or crushed prior to Substantial Completion.

END OF SECTION 16856