

**DEPARTMENT OF VETERANS AFFAIRS  
VHA MASTER SPECIFICATIONS**

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**SECTION 00 01 15**  
**LIST OF DRAWING SHEETS**

The drawings listed below accompanying this specification form a part of the contract.

<u>Drawing No.</u>	<u>Title</u>
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C1	Site Plan and Details
S1	Structural Plans and Details
S2	Framing Plans and Details
A1	Architectural Plans (Demo, New, Roof, Refl. Clg)
A2	Architectural Bldg. Elev, Dtls & Schedules
P1	HVAC, Fire Suppression Plan + Plumbing Plan
E1	Electrical Plans

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**SECTION 01 00 00 GENERAL REQUIREMENTS**

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## **PART 1 - GENERAL**

### **1.01 SAFETY REQUIREMENTS**

Refer to section 01 35 26, SAFETY REQUIREMENTS for safety and infection control requirements.

### **1.02 GENERAL INTENTION**

- A. Contractor shall completely prepare site for building operations, including demolition and removal of existing structures, and furnish labor and materials and perform work for 538-CSI-401 at VAMC Chillicothe, Ohio as required by drawings and specifications.
- B. Visits to the site by Bidders will be as outlined in the solicitation.
- C. All employees of the general contractor and subcontractors shall adhere to the Chillicothe VAMC contractor identification process and obtain VA issued badges. All employees of general contractor and subcontractors shall comply with VA security management program, be identified by project and employer, and restricted from unauthorized access.

### **D. REQUEST FOR INFORMATION**

In the event an explanation or interpretation of the drawings or specifications is necessary, submit the request using an RFI (Request for Information) Form. Such requests shall be submitted to the Contracting Officer soon enough to allow a reply so as to effect the project as little as possible.

### **1.03 STATEMENT OF BID ITEM(S)**

See Block 10, Standard Form (SF) 1442, and any continuation thereto, for a detailed list of Bid Items.

### **1.04 SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR**

Drawings and contract documents may be obtained from the website where the solicitation is posted. Additional copies will be at Contractor's expense,.

### **1.05 CONSTRUCTION SECURITY REQUIREMENTS**

#### **A. Security Plan:**

- 1. The security plan defines both physical and administrative security procedures that will remain effective for the entire duration of the project.
- 2. The General Contractor is responsible for assuring that all sub-contractors working on the project and their employees also comply with these regulations.

#### **B. Security Procedures:**

- 1. General Contractor's employees shall not enter the project site without appropriate badge. They may also be subject to inspection of their personal effects when entering or leaving the project site.
- 2. No photography of VA premises is allowed without written permission of the Contracting Officer.
- 3. VA reserves the right to close down or shut down the project site and order General Contractor's employees off the premises in the event of a national emergency. The General Contractor may return to the site only with the written approval of the Contracting Officer.

#### **C. Not Applicable**

#### **D. Key Control:**

- 1. Any keys necessary to gain entry to work areas or other spaces associated with performing work will be issued to the Contractor's representative on a daily basis. Keys will be signed out after 7:30 a.m. and returned before 4:00 p.m. from the Engineering Office, Building 21, each day when necessary to gain access. Failure to return any issued keys may result in a charge to include costs to re-key areas associated with the keys involved.

2. The General Contractor shall provide duplicate keys and lock combinations to the Contracting officers representative (COR) for the purpose of security inspections of every area of project including tool boxes and parked machines and take any emergency action.

3. See Section 08 71 00, DOOR HARDWARE for permanent lock cylinder requirements.

E. Not Applicable :

F. Motor Vehicle Restrictions

Reference Chillicothe VAMC Policy Memorandum No. 07-29, Parking and Motor Vehicle Operations, and Designated Parking for Contractors and Contractor Employees exhibits.

#### **1.06 OPERATIONS AND STORAGE AREAS**

The following paragraphs are in addition to (FAR 52.236-10)

- A. The Contractor shall confine all operations (including storage of materials) on Government premises to areas authorized or approved by the Contracting Officer. The Contractor shall hold and save the Government, its officers and agents, free and harmless from liability of any nature occasioned by the Contractor's performance.
- B. Temporary buildings (e.g., storage sheds, shops, offices) and utilities may be erected by the Contractor only with the approval of the Contracting Officer and shall be built with labor and materials furnished by the Contractor without expense to the Government. No fuel storage tanks are acceptable for contractor staging areas. The temporary buildings and utilities shall remain the property of the Contractor and shall be removed by the Contractor at its expense upon completion of the work. The Contractor shall, under regulations prescribed by the Contracting Officer, use only established roadways, or use temporary roadways constructed by the Contractor when and as authorized by the Contracting Officer. When materials are transported in prosecuting the work, vehicles shall not be loaded beyond the loading capacity recommended by the manufacturer of the vehicle or prescribed by any Federal, State, or local law or regulation. When it is necessary to cross curbs or sidewalks, the Contractor shall protect them from damage. The Contractor shall repair or pay for the repair of any damaged curbs, sidewalks, roads, or lawn areas.
- D. Working space and space available for storing materials shall be as shown on the drawings, and as determined by the COR.
- E. Workmen are subject to rules of Medical Center applicable to their conduct.
- F. Execute work so as to interfere as little as possible with normal functioning of Medical Center as a whole, including operations of utility services, fire protection systems and any existing equipment, and with work being done by others. Use of equipment and tools that transmit vibrations and noises through the building structure, are not permitted in buildings that are occupied, during construction, jointly by patients or medical personnel, and Contractor's personnel, except as permitted by COR where required by limited working space.
  - 1. Do not store materials and equipment in other than assigned areas.
  - 2. Schedule delivery of materials and equipment to immediate construction working areas within buildings in use by Department of Veterans Affairs in quantities sufficient for not more than two work days. Provide unobstructed access to Medical Center areas required to remain in operation.
  - 3. Where access by Medical Center personnel to vacated portions of buildings is not required, storage of Contractor's materials and equipment will be permitted subject to fire and safety requirements, and approval of the COR.
- G. Phasing:



The Medical Center must maintain its operation 24 hours a day 7 days a week. Therefore, any interruption in service must be scheduled and coordinated with the COR to ensure that no lapses in operation occur. It is the CONTRACTOR'S responsibility to develop a work plan and schedule detailing, at a minimum, the procedures to be employed, the equipment and materials to be used, the interim life safety measure to be used during the work, and a schedule defining the duration of the work with milestone subtasks.

To insure such executions, Contractor shall furnish the COR with a schedule of approximate phasing dates on which the Contractor intends to accomplish work in each specific area of site, building or portion thereof. In addition, Contractor shall notify the COR two weeks in advance of the proposed date of starting work in each specific area of site, building or portion thereof. Arrange such phasing dates to insure accomplishment of this work in successive phases mutually agreeable to COR and Contractor.

- H. All building areas adjacent to this project will be occupied during performance of work.

Contractor shall take all measures and provide all material necessary for protecting existing equipment and property in affected areas of construction against dust and debris, so that equipment and affected areas to be used in the Medical Centers operations will not be hindered. Contractor shall permit access to Department of Veterans Affairs personnel and patients through other construction areas which serve as routes of access to such affected areas and equipment. These routes whether access or egress shall be isolated from the construction area by temporary partitions and have walking surfaces, lighting etc to facilitate patient and staff access. Coordinate alteration work in areas occupied by Department of Veterans Affairs so that Medical Center operations will continue during the construction period. This may include evening or weekend work.

- I. Construction Fence: Before construction operations begin, Contractor shall provide a chain link construction fence, six feet minimum height, around the construction area indicated on the drawings. Provide gates as required for access with necessary hardware, including hasps and padlocks. Fasten fence fabric to terminal posts with tension bands and to line posts and top and bottom rails with tie wires spaced at maximum 375mm (15 inches). Bottom of fences shall extend to 25mm (one inch) above grade. Details of fence construction and finish thereof shall be submitted to COR for approval. Remove the fence when directed by COR .
- J. When a building and/or construction site is turned over to Contractor, Contractor shall accept entire responsibility including upkeep and maintenance therefore:
1. Contractor shall maintain a minimum temperature of 4 degrees C (40 degrees F) at all times, except as otherwise specified.
  2. Contractor shall maintain in operating condition existing fire protection and alarm equipment. In connection with fire alarm equipment, Contractor shall make arrangements for pre inspection of site with Chillicothe VAMC Fire Department required to respond to an alarm from Contractor's employee or watchman.
- K. Utilities Services: Maintain existing utility services for Medical Center at all times. Provide temporary facilities, labor, materials, equipment, connections, and utilities to assure uninterrupted services. Where necessary to cut existing water, steam, gases, sewer or air pipes, or conduits, wires, cables, etc. of utility services or of fire protection systems and communications systems (including telephone), they shall be cut and capped at suitable places where shown; or, in absence of such indication, where directed by COR .
1. No utility service such as water, gas, steam, sewers or electricity, or fire protection systems and communications systems may be interrupted without prior approval of COR . Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished, work on any energized circuits or equipment shall not commence without a detailed work plan, the Medical Center Director's prior knowledge and written approval.

2. Contractor shall submit a request to interrupt any such services to COR , in writing, 7 days in advance of proposed interruption. Request shall state reason, date, exact time of, and approximate duration of such interruption.
  3. Contractor will be advised (in writing) of approval of request, or of which other date and/or time such interruption will cause least inconvenience to operations of Medical Center . Interruption time approved by Medical Center may occur at other than Contractor's normal working hours.
  4. Major interruptions of any system must be requested, in writing, at least 15 calendar days prior to the desired time and shall be performed as directed by the COR .
  5. In case of a contract construction emergency, service will be interrupted on approval of COR . Such approval will be confirmed in writing as soon as practical.
  6. Access to Data Rooms requires escorts at all times. Access requests must be requested in writing a minimum of 7 days in advance of the proposed dates of work. Requests shall state reason, date, exact time of, and approximate duration of such work activity.
- L. Abandoned Lines: All service lines such as wires, cables, conduits, ducts, pipes and the like, and their hangers or supports, which are to be abandoned but are not required to be entirely removed, shall be sealed, capped or plugged at the main, branch or panel they originate from. The lines shall not be capped in finished areas, but shall be removed and sealed, capped or plugged in ceilings, within furred spaces, in unfinished areas, or within walls or partitions; so that they are completely behind the finished surfaces.
- M. To minimize interference of construction activities with flow of Medical Center traffic, comply with the following:
1. Keep roads, walks and entrances to grounds, to parking and to occupied areas of buildings clear of construction materials, debris and standing construction equipment and vehicles. Wherever excavation for new utility lines cross existing roads, at least one lane must be open to traffic at all times with approval.
  2. Method and scheduling of required cutting, altering and removal of existing roads, walks and entrances must be approved by the COR .
- N. Coordinate the work for this contract with other construction operations as directed by COR . This includes the scheduling of traffic and the use of roadways, as specified in Article, USE OF ROADWAYS.
- O. Not Applicable
- P. Hours of Work:
1. The work of this contract is to be executed between 7:30 a.m. and 4:00 p.m., Monday through Friday, except as required by the specifications and/or otherwise authorized by the COR. Submit in writing to the COR requests for proposed hours of work changes. Work hours shall be between 1800 and 0500 during certain phases including (but not limited to):
    - a. Demolition of brick veneer and exterior door.
    - b. Sensitive utility outages.
  2. Hours of work may vary depending on the area of work being performed. Work in occupied spaces shall be scheduled at times convenient to the occupant and the Medical Center. Areas adjacent to the work area include Radiology and Sterile Processing Supplies (SPS). No work will be performed on Government recognized holidays, except as required by the specifications and/or otherwise authorized by the COR.

3. Hot work shall stop prior to the specified end of work day at a minimum equal to the time required for final inspection.

#### 1.07 ALTERATIONS

- A. Survey: Before any work is started, the Contractor shall make a thorough survey with the COR and a representative of VA Acquisition and Material Management Service, of areas of buildings in which alterations occur and areas which are anticipated routes of access, and furnish a report, signed by all three, to the Contracting Officer. This report shall list by rooms and spaces:
  1. Existing condition and types of resilient flooring, doors, windows, walls and other surfaces not required to be altered throughout affected areas of buildings.
  2. Existence and conditions of items such as plumbing fixtures and accessories, electrical fixtures, equipment, venetian blinds, shades, etc., required by drawings to be either reused or relocated, or both.
  3. Shall note any discrepancies between drawings and existing conditions at site.
  4. Shall designate areas for working space, materials storage and routes of access to areas within buildings where alterations occur and which have been agreed upon by Contractor COR.
- B. Any items required by drawings to be either reused or relocated or both, found during this survey to be nonexistent, or in opinion of COR and Acquisition and Material Management Service Representative, to be in such condition that their use is impossible or impractical, shall be furnished and/or replaced by Contractor with new items in accordance with specifications which will be furnished by Government. Provided the contract work is changed by reason of this subparagraph B, the contract will be modified accordingly, under provisions of clause entitled "DIFFERING SITE CONDITIONS" (FAR 52.236-2) and "CHANGES" (FAR 52.243-4 and VAAR 852.236-88).
- C. Re-Survey: Thirty days before expected partial or final inspection date, the Contractor and COR together shall make a thorough re-survey of the areas of buildings involved. They shall furnish a report on conditions then existing, of resilient flooring, doors, windows, walls and other surfaces as compared with conditions of same as noted in first condition survey report:

Re-survey report shall also list any damage caused by Contractor to such flooring and other surfaces, despite protection measures; and, will form basis for determining extent of repair work required of Contractor to restore damage caused by Contractor's workmen in executing work of this contract.
- D. Protection: Provide the following protective measures:
  1. Wherever existing roof surfaces are disturbed they shall be protected against water infiltration. In case of leaks, they shall be repaired immediately upon discovery.
  2. Temporary protection against damage for portions of existing structures and grounds where work is to be done, materials handled and equipment moved and/or relocated.
  3. Protection of interior of existing structures at all times, from damage, dust and weather inclemency. Wherever work is performed, floor surfaces that are to remain in place shall be adequately protected prior to starting work, and this protection shall be maintained intact until all work in the area is completed.
  4. Dampen debris to keep down dust.
  5. Provide temporary construction partitions as described in Specification Section 01 35 26 paragraph Temporary Construction Partitions.
  6. Block off ducts and diffusers to prevent circulation of dust into occupied areas during construction. Coordinate with COR.
  7. See Specification Section 01 35 26 paragraph Infection Control for additional required measures.

#### **1.08 DISPOSAL AND RETENTION**

- A. Materials and equipment accruing from work removed and from demolition of buildings or structures, or parts thereof, shall be disposed of as follows:

1. Reserved items which are to remain property of the Government are noted on drawings or in specifications as items to be stored. Items that remain property of the Government shall be removed or dislodged from present locations in such a manner as to prevent damage which would be detrimental to re installation and reuse. The contractor shall secure and store the items until reinstallation. .
2. Items not reserved shall become property of the Contractor and be removed by Contractor from Medical Center .
3. Items of portable equipment and furnishings located in rooms and spaces in which work is to be done under this contract shall remain the property of the Government. When rooms and spaces are vacated by the Department of Veterans Affairs during the alteration period, such items which are NOT required by drawings and specifications to be relocated, reused, or demolished will be removed by the Government in advance of work to avoid interfering with Contractor's operation.
4. Not Applicable

#### **1.09 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS**

The following paragraph is in addition to FAR 52.236-9 Clause PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS

- A. The Contractor shall preserve and protect all structures, equipment, and vegetation (such as trees, shrubs, and grass) on or adjacent to the work site, which are not to be removed and which do not unreasonably interfere with the work required under this contract. The Contractor shall only remove trees when specifically authorized to do so, and shall avoid damaging vegetation that will remain in place. If any limbs or branches of trees are broken during contract performance, or by the careless operation of equipment, or by workmen, the Contractor shall trim those limbs or branches with a clean cut and paint the cut with a tree-pruning compound as directed by the Contracting Officer.
- B. The Contractor shall protect from damage all existing improvements and utilities at or near the work site and on adjacent property of a third party, the locations of which are made known to or should be known by the Contractor. The Contractor shall repair any damage to those facilities, including those that are the property of a third party, resulting from failure to comply with the requirements of this contract or failure to exercise reasonable care in performing the work. If the Contractor fails or refuses to repair the damage promptly, the Contracting Officer may have the necessary work performed and charge the cost to the Contractor.
- C. Refer to Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS, for additional requirements on protecting vegetation, soils and the environment. Refer to Articles, "Alterations", "Restoration", and "Operations and Storage Areas" for additional instructions concerning repair of damage to structures and site improvements.
- D. Not Applicable

#### **1.10 RESTORATION**

- A. Remove, cut, alter, replace, patch and repair existing work as necessary to install new work. Except as otherwise shown or specified, do not cut, alter or remove any structural work, and do not disturb any ducts, plumbing, steam, gas, or electric work without approval of the COR . Existing work to be altered or extended and that is found to be defective in any way, shall be reported to the COR before it is disturbed. Materials and workmanship used in restoring work, shall conform in type and quality to that of original existing construction, except as otherwise shown or specified.

- B. Upon completion of contract, deliver work complete and undamaged. Existing work (walls, ceilings, partitions, floors, mechanical and electrical work, lawns, paving, roads, walks, etc.) disturbed or removed as a result of performing required new work, shall be patched, repaired, reinstalled, or replaced with new work, and refinished and left in as good condition as existed before commencing work.
- C. At Contractor's own expense, Contractor shall immediately restore to service and repair any damage caused by Contractor's workmen to existing piping and conduits, wires, cables, etc., of utility services or of fire protection systems and communications systems (including telephone) which are not scheduled for discontinuance or abandonment.
- D. Expense of repairs to such utilities and systems not shown on drawings or locations of which are unknown will be covered by adjustment to contract time and price in accordance with clause entitled "CHANGES" (FAR 52.243-4 and VAAR 852.236-88) and "DIFFERING SITE CONDITIONS" (FAR 52.236-2).

#### **1.11 PHYSICAL DATA**

- A. 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 indications of physical conditions on the drawings and in the specifications are the result of site investigations by Terracon (report dated April 26, 2013).

(FAR 52.236 4)

- B. Government does not guarantee that other materials will not be encountered nor that proportions, conditions or character of several materials will not vary from those indicated by explorations. Bidders are expected to examine site of work and logs of borings; and, after investigation, decide for themselves character of materials and make their bids accordingly. Upon proper application to Department of Veterans Affairs, bidders will be permitted to make subsurface explorations of their own at site.

#### **1.12 PROFESSIONAL SURVEYING SERVICES**

A registered professional land surveyor or registered civil engineer whose services are retained and paid for by the Contractor shall perform services specified herein and in other specification sections. The Contractor shall certify that the land surveyor or civil engineer is not one who is a regular employee of the Contractor, and that the land surveyor or civil engineer has no financial interest in this contract.

#### **1.13 LAYOUT OF WORK**

- A. The Contractor shall lay out the work from Government established base lines, indicated on the drawings, and shall be responsible for all measurements in connection with the layout. The Contractor shall furnish, at Contractor's own expense, all stakes, templates, platforms, equipment, tools, materials, and labor required to lay out any part of the work.  
(FAR 52.236-17)
- B. Establish and plainly mark center lines for each building and corner of column lines and/or addition to each existing building, and such other lines and grades that are reasonably necessary to properly assure that location, orientation, and elevations established for each such structure and/or addition are in accordance with lines and elevations shown on contract drawings.
- C. Following completion of general mass excavation and before any other permanent work is performed, establish and plainly mark (through use of appropriate batter boards or other means) sufficient additional survey control points or system of points as may be necessary to assure proper alignment,

orientation, and grade of all major features of work. Survey shall include, but not be limited to, location of lines and grades of footings, exterior walls, center lines of columns in both directions, major utilities and elevations of floor slabs:

Furnish survey points to the COR before any work (such as footings, floor slabs, columns, walls, utilities and other major controlling features) is placed.

- D. During progress of work, and particularly as work progresses from floor to floor, Contractor shall have line grades and plumbness of all major form work checked as meeting requirements of contract drawings.
- E. Whenever changes from contract drawings are made in line or grading requiring certificates, record such changes on a reproducible drawing, and forward these drawings upon completion of work to COR .
- F. The Contractor shall perform the surveying and layout work of this and other articles and specifications.

#### **1.14 AS-BUILT DRAWINGS**

- A. The contractor shall maintain one full size sets of as-built drawings which will be kept current during construction of the project, to include all contract changes, modifications and clarifications.
- B. All variations shall be shown in the same general detail as used in the contract drawings. To insure compliance, as-built drawings shall be made available for the COR review, as often as requested.
- C. Contractor shall deliver two approved completed sets of as-built drawings in the electronic version (scanned PDF) to the COR within 15 calendar days after each completed phase and after the acceptance of the project by the COR.
- D. Paragraphs A, B, & C shall also apply to all shop drawings.

#### **1.15 USE OF ROADWAYS**

For hauling, use only established public roads and roads on Medical Center property and, when authorized by the COR , such temporary roads which are necessary in the performance of contract work. Temporary roads shall be constructed and restoration performed by the Contractor at Contractor's expense. When necessary to cross curbing, sidewalks, or similar construction, they must be protected by well-constructed bridges.

#### **1.16 NOT APPLICABLE**

#### **1.17 TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT**

- A. Use of new installed mechanical and electrical equipment to provide heat, ventilation, plumbing, light and power will be permitted subject to written approval and compliance with the following provisions:
  - 1. Permission to use each unit or system must be given by COR in writing. If the equipment is not installed and maintained in accordance with the written agreement and following provisions, the COR will withdraw permission for use of the equipment.
  - 2. Electrical installations used by the equipment shall be completed in accordance with the drawings and specifications to prevent damage to the equipment and the electrical systems, i.e. transformers, relays, circuit breakers, fuses, conductors, motor controllers and their overload elements shall be properly sized, coordinated and adjusted. Installation of temporary electrical equipment or devices shall be in accordance with the most recent addition of NFPA 70, National Electrical Code, Article 590, Temporary Installations. Voltage supplied to each item of equipment shall be verified to be correct and it shall be determined that motors are not overloaded. The electrical equipment shall be thoroughly cleaned before using it and again immediately before final inspection including vacuum cleaning and wiping clean interior and exterior surfaces.

3. Units shall be properly lubricated, balanced, and aligned. Vibrations must be eliminated.
  4. Automatic temperature control systems for preheat coils shall function properly and all safety controls shall function to prevent coil freeze up damage.
  5. The air filtering system utilized shall be that which is designed for the system when complete, and all filter elements shall be replaced at completion of construction and prior to testing and balancing of system.
  6. All components of heat production and distribution system, metering equipment, condensate returns, and other auxiliary facilities used in temporary service shall be cleaned prior to use; maintained to prevent corrosion internally and externally during use; and cleaned, maintained and inspected prior to acceptance by the Government.
- B. Prior to final inspection, the equipment or parts used which show wear and tear beyond normal, shall be replaced with identical replacements, at no additional cost to the Government.
  - C. This paragraph shall not reduce the requirements of the mechanical and electrical specifications sections.
  - D. Any damage to the equipment or excessive wear due to prolonged use will be repaired replaced by the contractor at the contractor's expense.

**1.18 NOT APPLICABLE**

**1.19 NOT APPLICABLE**

**1.20 TEMPORARY TOILETS**

Contractor shall provide for use of all Contractor's workmen ample temporary sanitary toilet accommodations. Keep such places clean and free from flies, and all connections and appliances connected therewith are to be removed prior to completion of contract, and premises left perfectly clean.

**1.21 AVAILABILITY AND USE OF UTILITY SERVICES**

- A. The Government shall make all reasonably required amounts of utilities available to the Contractor from existing outlets and supplies, as specified in the contract. The Contractor shall carefully conserve any utilities furnished without charge. Failure to stop leakage or other waste will be cause for revocation (at COR's discretion).
- B. The Contractor, at Contractor's expense and in a workmanlike manner, in compliance with code and as satisfactory to the Contracting Officer, shall install and maintain all necessary temporary connections and distribution lines, and all meters required to measure the amount of electricity used for the purpose of determining charges. Before final acceptance of the work by the Government, the Contractor shall remove all the temporary connections, distribution lines, meters, and associated paraphernalia and repair restore the infrastructure as required.
- C. Contractor shall install meters at Contractor's expense and furnish the Medical Center a monthly record of the Contractor's usage of electricity as hereinafter specified.
- D. Heat: Furnish temporary heat necessary to prevent injury to work and materials through dampness and cold. Temporary heating plans must be approved by the Chillicothe VAMC Fire Department; refer to Specification Section 01 35 26 Safety Requirements. Use of open salamanders or any temporary heating devices which may be fire hazards or may smoke and damage finished work, will not be permitted. Maintain minimum temperatures as specified for various materials:

Obtain heat by connecting to Medical Center steam distribution system. Steam is available at no cost to Contractor. Maintain connections, pipe, fittings and fixtures and conserve steam-use so none is

wasted. Failure to stop leakage or other waste will be cause for revocation (at COR's discretion), of use of steam from the Medical Center's system

E. Electricity (for Construction and Testing): Furnish all temporary electric services.

Obtain electricity by connecting to the Medical Center electrical distribution system. The Contractor shall meter and pay for electricity required for electric cranes and hoisting devices, electrical welding devices and any electrical heating devices providing temporary heat. Electricity for all other uses is available at no cost to the Contractor.

F. Water (for Construction and Testing): Furnish temporary water service.

1. Obtain water by connecting to the Medical Center water distribution system. Provide reduced pressure backflow preventer at each connection as per code. For connection to hose bibs a vacuum breaker shall be used. In freezing conditions when the water source is not in use the vacuum breaker shall be removed. Water is available at no cost to the Contractor.

2. Maintain connections, pipe, fittings and fixtures and conserve water-use so none is wasted. Failure to stop leakage or other wastes will be cause for revocation (at COR's discretion) of use of water from Medical Center's system.

**1.22 NOT APPLICABLE**

**1.23 TESTS**

- A. Pre-test mechanical and electrical equipment and systems and make corrections required for proper operation of such systems before requesting final tests. Final test will not be conducted unless pre tested.
- B. Conduct final tests required in various sections of specifications in presence of an authorized representative of the Contracting Officer. Contractor shall furnish all labor, materials, equipment, instruments, and forms, to conduct and record such tests.
- C. Mechanical and electrical systems shall be balanced, controlled and coordinated. A system is defined as the entire system which must be coordinated to work together during normal operation to produce results for which the system is designed. For example, air conditioning supply air is only one part of entire system which provides comfort conditions for a building. Other related components are return air, exhaust air, steam, chilled water, refrigerant, hot water, controls and electricity, etc. Another example of a system which involves several components of different disciplines is a boiler installation. Efficient and acceptable boiler operation depends upon the coordination and proper operation of fuel, combustion air, controls, steam, feedwater, condensate and other related components.
- D. All related components as defined above shall be functioning when any system component is tested. Tests shall be completed within a reasonably period of time during which operating and environmental conditions remain reasonably constant and are typical of the design conditions.
- E. Individual test result of any component, where required, will only be accepted when submitted with the test results of related components and of the entire system.

**1.24 INSTRUCTIONS**

- A. Contractor shall furnish Maintenance and Operating manuals (hard copies and electronic) and verbal instructions when required by the various sections of the specifications and as hereinafter specified.
- B. Manuals: Maintenance and operating manuals and one compact disc (four hard copies and one electronic copy each) for each separate piece of equipment shall be delivered to the COR coincidental with the delivery of the equipment to the job site. Manuals shall be complete, detailed guides for the maintenance and operation of equipment. They shall include complete information necessary for starting, adjusting, maintaining in continuous operation for long periods of time and dismantling and reassembling of the complete units and sub assembly components. Manuals shall



include an index covering all component parts clearly cross referenced to diagrams and illustrations. Illustrations shall include "exploded" views showing and identifying each separate item. Emphasis shall be placed on the use of special tools and instruments. The function of each piece of equipment, component, accessory and control shall be clearly and thoroughly explained. All necessary precautions for the operation of the equipment and the reason for each precaution shall be clearly set forth. Manuals must reference the exact model, style and size of the piece of equipment and system being furnished. Manuals referencing equipment similar to but of a different model, style, and size than that furnished will not be accepted.

- C. Instructions: Contractor shall provide qualified, factory trained manufacturers' representatives to give detailed training to assigned Department of Veterans Affairs personnel in the operation and complete maintenance for each piece of equipment. All such training will be at the job site. These requirements are more specifically detailed in the various technical sections. Instructions for different items of equipment that are component parts of a complete system, shall be given in an integrated, progressive manner. All instructors for every piece of component equipment in a system shall be available until instructions for all items included in the system have been completed. This is to assure proper instruction in the operation of inter-related systems. All instruction periods shall be at such times as scheduled by the COR and shall be considered concluded only when the COR is satisfied in regard to complete and thorough coverage. The contractor shall submit a course outline with associated material to the COR for review and approval prior to scheduling training to ensure the subject matter covers the expectations of the VA and the contractual requirements. The Department of Veterans Affairs reserves the right to request the removal of, and substitution for, any instructor who, in the opinion of the COR, does not demonstrate sufficient qualifications in accordance with requirements for instructors above.

#### **1.25 NOT APPLICABLE**

#### **1.26 RELOCATED EQUIPMENT ITEMS**

- A. Contractor shall disconnect, dismantle as necessary, remove and reinstall in new location, all existing equipment and items shown to be relocated by the Contractor.
- B. Perform relocation of such equipment or items at such times and in such a manner as directed by the COR.
- C. Suitably cap existing service lines, such as steam, condensate return, water, drain, gas, air, vacuum and/or electrical, at the main whenever such lines are disconnected from equipment to be relocated. Remove abandoned lines in finished areas and cap as specified herein before under paragraph "Abandoned Lines".
- D. Provide all mechanical and electrical service connections, fittings, fastenings and any other materials necessary for assembly and installation of relocated equipment; and leave such equipment in proper operating condition.
- E. All service lines such as noted above for relocated equipment shall be in place at point of relocation ready for use before any existing equipment is disconnected. Make relocated existing equipment ready for operation or use immediately after reinstallation.

**1.27 NOT APPLICABLE**

**1.28 NOT APPLICABLE**

**1.29 NOT APPLICABLE**

**1.30 NOT APPLICABLE**

**1.31 NOT APPLICABLE**

**1.32 HISTORIC PRESERVATION**

- A. Where the Contractor or any of the Contractor's employees or subcontractors, prior to or during the construction work, are advised of or discover any historical artifacts or other items which are or could reasonably be suspected to be of historical significance, the Contractor shall stop work so as to not disturb or damage the item and immediately notify the COR.
- B. If in the course of any earth disturbing activities human remains are discovered, or anything is discovered that could be reasonably suspected to be human remains, the Contractor shall immediately stop all work within 100 feet of the discovery and notify the COR.
- C. Prior to participating in construction or ground disturbance all contractor personnel involved in the construction or ground disturbance activity shall complete historic preservation training established by the medical center. All contractor personnel will be required to sign acknowledging receipt of the training. Training for this activity shall be approximately 30 minutes in length, and be given at the medical center.

**1.33 NOT APPLICABLE**

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

--- END OF SECTION – GENERAL REQUIREMENTS ---

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GENERAL REQUIREMENTS

## **SECTION 01 33 23**

### **SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES**

#### **PART 1 – GENERAL**

##### **1.1 DESCRIPTION**

- A. This specification defines the general requirements and procedures for submittals. A submittal is information submitted for VA review to establish compliance with the contract documents.
- B. Detailed submittal requirements are found in the technical sections of the contract specifications. The Contracting Officer may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective technical specifications at no additional cost to the government.
- C. VA approval of a submittal does not relieve the Contractor of the responsibility for any error which may exist. The Contractor is responsible for fully complying with all contract requirements and the satisfactory construction of all work, including the need to check, confirm, and coordinate the work of all subcontractors for the project. Non-compliant material incorporated in the work will be removed and replaced at the Contractor's expense.

##### **1.2 DEFINITIONS**

- A. Preconstruction Submittals: Submittals which are required prior to issuing contract notice to proceed or starting construction. For example, Certificates of insurance; Surety bonds; Site-specific safety plan; Construction progress schedule; Schedule of values; Submittal register; List of proposed subcontractors.
- B. Shop Drawings: Drawings, diagrams, and schedules specifically prepared to illustrate some portion of the work. Drawings prepared by or for the Contractor to show how multiple systems and interdisciplinary work will be integrated and coordinated.
- C. Product Data: Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions, and brochures, which describe and illustrate size, physical appearance, and other characteristics of materials, systems, or equipment for some portion of the work. Samples of warranty language when the contract requires extended product warranties.
- D. Samples: Physical examples of materials, equipment, or workmanship that illustrate functional and aesthetic characteristics of a material or product and establish standards by which the work can be judged. Color samples from the manufacturer's standard line (or custom color samples if specified) to be used in selecting or approving colors for the project. Field samples and mock-ups constructed to establish standards by which the ensuing work can be judged.
- E. Design Data: Calculations, mix designs, analyses, or other data pertaining to a part of work.

- F. Test Reports: Report which includes findings of a test required to be performed by the Contractor on an actual portion of the work. Report which includes finding of a test made at the job site or on sample taken from the job site, on portion of work during or after installation.
- G. Certificates: Document required of Contractor, or of a manufacturer, supplier, installer, or subcontractor through Contractor. The purpose is to document procedures, acceptability of methods, or personnel qualifications for a portion of the work.
- H. Manufacturer's Instructions: Pre-printed material describing installation of a product, system, or material, including special notices and MSDS concerning impedances, hazards, and safety precautions.
- I. Manufacturer's Field Reports: Documentation of the testing and verification actions taken by manufacturer's representative at the job site on a portion of the work, during or after installation, to confirm compliance with manufacturer's standards or instructions. The documentation must indicate whether the material, product, or system has passed or failed the test.
- J. Operation and Maintenance Data: Manufacturer data that is required to operate, maintain, troubleshoot, and repair equipment, including manufacturer's help, parts list, and product line documentation. This data shall be incorporated in an operations and maintenance manual.
- K. Closeout Submittals: Documentation necessary to properly close out a construction contract. For example, Record Drawings and as-built drawings. Also, submittal requirements necessary to properly close out a phase of construction on a multi-phase contract.

### **1.3 SUBMITTAL REGISTER**

- A. The submittal register will list items of equipment and materials for which submittals are required by the specifications. This list may not be all inclusive and additional submittals may be required by the specifications. The Contractor is not relieved from supplying submittals required by the contract documents but which have been omitted from the submittal register.
- B. The submittal register will serve as a scheduling document for submittals and will be used to control submittal actions throughout the contract period.
- C. The Contractor shall track all submittals by maintaining a complete list, including completion of all data columns, including dates on which submittals are received and returned by the VA.
- D. The Contractor shall update the submittal register as submittal actions occur and maintain the submittal register at the project site until final acceptance of all work by Contracting Officer.

### **1.4 SUBMITTAL SCHEDULING**

- A. Submittals are to be scheduled, submitted, reviewed, and approved prior to the acquisition of the material or equipment.
- B. Coordinate scheduling, sequencing, preparing, and processing of submittals with performance of work so that work will not be delayed by submittal processing. Allow time for potential resubmittal.

- C. No delay costs or time extensions will be allowed for time lost in late submittals or resubmittals.
- D. All submittals are required to be approved prior to the start of the specified work activity.

### **1.5 SUBMITTAL PREPARATION**

- A. Each submittal is to be complete and in sufficient detail to allow ready determination of compliance with contract requirements.
- B. Collect required data for each specific material, product, unit of work, or system into a single submittal. Prominently mark choices, options, and portions applicable to the submittal. Partial submittals will not be accepted for expedition of construction effort. Submittal will be returned without review if incomplete.
- C. If available product data is incomplete, provide Contractor-prepared documentation to supplement product data and satisfy submittal requirements.
- D. All irrelevant or unnecessary data shall be removed from the submittal to facilitate accuracy and timely processing. Submittals that contain the excessive amount of irrelevant or unnecessary data will be returned with review.
- E. Provide a transmittal form for each submittal with the following information:
  - 1. Project title, location and number.
  - 2. Construction contract number.
  - 3. Date of the drawings and revisions.
  - 4. Name, address, and telephone number of subcontractor, supplier, manufacturer, and any other subcontractor associated with the submittal.
  - 5. List paragraph number of the specification section and sheet number of the contract drawings by which the submittal is required.
  - 6. When a resubmission, add alphabetic suffix on submittal description. For example, submittal 18 would become 18A, to indicate resubmission.
  - 7. Product identification and location in project.
- F. The Contractor is responsible for reviewing and certifying that all submittals are in compliance with contract requirements before submitting for VA review. Proposed deviations from the contract requirements are to be clearly identified. All deviations submitted must include a side by side comparison of item being proposed against item specified. Failure to point out deviations will result in the VA requiring removal and replacement of such work at the Contractor's expense.
- G. Stamp, sign, and date each submittal transmittal form indicating action taken.
- H. Stamp used by the Contractor on the submittal transmittal form to certify that the submittal meets contract requirements is to be similar to the following:

CONTRACTOR	
(Firm Name)	
_____ Approved	
_____ Approved with corrections as noted on submittal data and/or	
attached sheets(s)	
SIGNATURE: _____	
TITLE: _____	
DATE: _____	

## 1.6 SUBMITTAL FORMAT AND TRANSMISSION

- A. Provide submittals in electronic format, with the exception of material samples. Use PDF as the electronic format, unless otherwise specified or directed by the Contracting Officer.
- B. Compile the electronic submittal file as a single, complete document. Name the electronic submittal file specifically according to its contents.
- C. Electronic files must be of sufficient quality that all information is legible. Generate PDF files from original documents so that the text included in the PDF file is both searchable and can be copied. If documents are scanned, Optical Character Resolution (OCR) routines are required.
- D. E-mail electronic submittal documents smaller than 5MB in size to e-mail addresses as directed by the Contracting Officer.

- E. Provide electronic documents over 5MB through an electronic FTP file sharing system. Confirm that the electronic FTP file sharing system can be accessed from the VA computer network. The Contractor is responsible for setting up, providing, and maintaining the electronic FTP file sharing system for the construction contract period of performance.
- F. Provide hard copies of submittals when requested by the Contracting Officer. Up to 3 additional hard copies of any submittal may be requested at the discretion of the Contracting Officer, at no additional cost to the VA.

## **1.7 SAMPLES**

- A. Submit two sets of physical samples showing range of variation, for each required item.
- B. Where samples are specified for selection of color, finish, pattern, or texture, submit the full set of available choices for the material or product specified.
- C. When color, texture, or pattern is specified by naming a particular manufacturer and style, include one sample of that manufacturer and style, for comparison.
- D. Before submitting samples, the Contractor is to ensure that the materials or equipment will be available in quantities required in the project. No change or substitution will be permitted after a sample has been approved.
- E. The VA reserves the right to disapprove any material or equipment which previously has proven unsatisfactory in service.
- F. Physical samples supplied maybe requested back for use in the project after reviewed and approved.

## **1.8 OPERATION AND MAINTENANCE DATA**

- A. Submit data specified for a given item within 30 calendar days after the item is delivered to the contract site.
- B. In the event the Contractor fails to deliver O&M Data within the time limits specified, the Contracting Officer may withhold from progress payments 50 percent of the price of the item with which such O&M Data are applicable.

## **1.9 TEST REPORTS**

SRE may require specific test after work has been installed or completed which could require contractor to repair test area at no additional cost to contract.

## **1.10 VA REVIEW OF SUBMITTALS AND RFIS**

- A. The VA will review all submittals for compliance with the technical requirements of the contract documents. The Architect-Engineer for this project will assist the VA in reviewing all submittals and determining contractual compliance. Review will be only for conformance with the applicable codes, standards and contract requirements.



- B. Period of review for submittals begins when the VA COR receives submittal from the Contractor.
- C. Period of review for each resubmittal is the same as for initial submittal.
- D. VA review period is 15 working days for submittals.
- E. VA review period is 10 working days for RFIs.
- F. The VA will return submittals to the Contractor with the following notations:
  - 1. "Approved": authorizes the Contractor to proceed with the work covered.
  - 2. "Approved as noted": authorizes the Contractor to proceed with the work covered provided the Contractor incorporates the noted comments and makes the noted corrections.
  - 3. "Disapproved, revise and resubmit": indicates noncompliance with the contract requirements or that submittal is incomplete. Resubmit with appropriate changes and corrections. No work shall proceed for this item until resubmittal is approved.
  - 4. "Not reviewed": indicates submittal does not have evidence of being reviewed and approved by Contractor or is not complete. A submittal marked "not reviewed" will be returned with an explanation of the reason it is not reviewed. Resubmit submittals after taking appropriate action.

#### **1.11 APPROVED SUBMITTALS**

- A. The VA approval of submittals is not to be construed as a complete check, and indicates only that the general method of construction, materials, detailing, and other information are satisfactory.
- B. VA approval of a submittal does not relieve the Contractor of the responsibility for any error which may exist. The Contractor is responsible for fully complying with all contract requirements and the satisfactory construction of all work, including the need to check, confirm, and coordinate the work of all subcontractors for the project. Non-compliant material incorporated in the work will be removed and replaced at the Contractor's expense.
- C. After submittals have been approved, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.
- D. Retain a copy of all approved submittals at project site, including approved samples.

#### **1.12 WITHHOLDING OF PAYMENT**

Payment for materials incorporated in the work will not be made if required approvals have not been obtained.

--- E N D ---

**SECTION 01 35 26 SAFETY REQUIREMENTS**

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## **PART 1 - GENERAL**

### **1.01 APPLICABLE PUBLICATIONS:**

Latest publications listed below form part of this Article to extent referenced. Publications are referenced in text by basic designations only.

A. American Society of Safety Engineers (ASSE):

1. A10.1-2011 Pre-Project & Pre-Task Safety and Health Planning
2. A10.34-2012 Protection of the Public on or Adjacent to Construction Sites
3. A10.38-2013 Basic Elements of an Employer's Program to Provide a Safe and Healthful Work Environment American National Standard Construction and Demolition Operations

B. American Society for Testing and Materials (ASTM):

E84-2013 Surface Burning Characteristics of Building Materials

C. The Facilities Guidelines Institute (FGI):

FGI Guidelines-2010 Guidelines for Design and Construction of Healthcare Facilities

D. National Fire Protection Association (NFPA):

1. 10-2013 Standard for Portable Fire Extinguishers
2. 30-2012 Flammable and Combustible Liquids Code
3. 51B-2014 Standard for Fire Prevention During Welding, Cutting and Other Hot Work
4. 70-2014 National Electrical Code
5. 70B-2013 Recommended Practice for Electrical Equipment Maintenance
6. 70E-2012 Standard for Electrical Safety in the Workplace
7. 99-2012 Health Care Facilities Code
8. 241-2013 Standard for Safeguarding Construction, Alteration, and Demolition Operations

E. The Joint Commission (TJC)

TJC Manual Comprehensive Accreditation and Certification Manual

F. U.S. Nuclear Regulatory Commission

10 CFR 20 Standards for Protection Against Radiation

G. U.S. Occupational Safety and Health Administration (OSHA):

1. 29 CFR 1904 Reporting and Recording Injuries & Illnesses
2. 29 CFR 1910 Safety and Health Regulations for General Industry
3. 29 CFR 1926 Safety and Health Regulations for Construction Industry
4. CPL 2-0.124 Multi-Employer Citation Policy

H. VHA Directive 2005-007

I. Chillicothe VAMC Standard Operating Procedures (SOP) and Policies

1. Engineering SOP #11 Fall Protection
2. Engineering SOP #12 Construction Project Inspections
3. Engineering SOP #13 Construction Risk Assessment and Infection Control Plan

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4. Engineering SOP #20 Confined Space Entry
5. Engineering SOP #30 Control of Hazardous Energy – Lockout Tagout
6. Engineering SOP #31 Hot Work Operations
7. Engineering SOP #44 Ladder Safety Practices
8. Engineering SOP #45 Excavation and Trenching
9. Engineering SOP #57 Coordinating Utility Outages
10. Not Used
11. Policy Memorandum No. 138-15 Electrical Safety
12. Chillicothe VAMC Safety and Infection Control Handbook for Contractors
13. Engineering SOP #32 Dig Permits

**1.02 DEFINITIONS:**

- A. OSHA "Competent Person" (CP). One who is capable of identifying existing and predictable hazards in the surroundings and working conditions which are unsanitary, hazardous or dangerous to employees, and who has the authorization to take prompt corrective measures to eliminate them (see 29 CFR 1926.32(f)).
- B. "Qualified Person" means one who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training and experience, has successfully demonstrated his ability to solve or resolve problems relating to the subject matter, the work, or the project.
- C. High Visibility Accident. Any mishap which may generate publicity or high visibility.
- D. Medical Treatment. Treatment administered by a physician or by registered professional personnel under the standing orders of a physician. Medical treatment does not include first aid treatment even though provided by a physician or registered personnel.
- E. Recordable Injuries or Illnesses. Any work-related injury or illness that results in:
  1. Death, regardless of the time between the injury and death, or the length of the illness;
  2. Days away from work (any time lost after day of injury/illness onset);
  3. Restricted work;
  4. Transfer to another job;
  5. Medical treatment beyond first aid;
  6. Loss of consciousness; or
  7. A significant injury or illness diagnosed by a physician or other licensed health care professional, even if it did not result in (1) through (6) above.

**1.03 REGULATORY REQUIREMENTS:**

In addition to the detailed requirements included in the provisions of this contract, comply with 29 CFR 1926, comply with 29 CFR 1910 as incorporated by reference within 29 CFR 1926, comply with ASSE A10.34, and all applicable federal, state, and local laws, ordinances, criteria, rules and regulations. Submit matters of interpretation of standards for resolution before starting work. Where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirements govern except with specific approval and acceptance by the Contracting Officer Representative.

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**1.04 ACCIDENT PREVENTION PLAN (APP):**

A. The APP (aka Construction Safety & Health Plan) shall interface with the Contractor's overall safety and health program. Include any portions of the Contractor's overall safety and health program referenced in the APP in the applicable APP element and ensure it is site-specific. The Government considers the Prime Contractor to be the "controlling authority" for all worksite safety and health of each subcontractor(s). Contractors are responsible for informing their subcontractors of the safety provisions under the terms of the contract and the penalties for noncompliance, coordinating the work to prevent one craft from interfering with or creating hazardous working conditions for other crafts, and inspecting subcontractor operations to ensure that accident prevention responsibilities are being carried out.

B. The APP shall be prepared as follows:

1. Written in English by a qualified person who is employed by the Prime Contractor articulating the specific work and hazards pertaining to the contract (model language can be found in ASSE A10.33). Specifically articulating the safety requirements found within these VA contract safety specifications.

2. Address both the Prime Contractors and the subcontractors work operations.

3. State measures to be taken to control hazards associated with materials, services, or equipment provided by suppliers.

4. Address all the elements/sub-elements and in order as follows:

a. SIGNATURE SHEET. Title, signature, and phone number of the following:

- i. Plan preparer (Qualified Person such as corporate safety staff person or contracted Certified Safety Professional with construction safety experience);
- ii. Plan approver (company/corporate officers authorized to obligate the company);
- iii. Plan concurrence (e.g., Chief of Operations, Corporate Chief of Safety, Corporate Industrial Hygienist, project manager or superintendent, project safety professional). Provide concurrence of other applicable corporate and project personnel (Contractor).

b. BACKGROUND INFORMATION. List the following:

- i. Contractor;
- ii. Contract number;
- iii. Project name;
- iv. Brief project description, description of work to be performed, and location; phases of work anticipated (these will require an AHA).

c. STATEMENT OF SAFETY AND HEALTH POLICY. Provide a copy of current corporate/company Safety and Health Policy Statement, detailing commitment to providing a safe and healthful workplace for all employees. The Contractor's written safety program goals, objectives, and accident experience goals for this contract should be provided.

d. RESPONSIBILITIES AND LINES OF AUTHORITIES. Provide the following:

- i. A statement of the employer's ultimate responsibility for the implementation of his SOH program;
- ii. Identification and accountability of personnel responsible for safety at both corporate and project level. Contracts specifically requiring safety or industrial hygiene personnel shall include a copy of their resumes.

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- iii. The names of Competent and/or Qualified Person(s) and proof of competency/qualification to meet specific OSHA Competent/Qualified Person(s) requirements must be attached.;
- iv. Requirements that no work shall be performed unless a designated competent person is present on the job site;
- v. Requirements for pre-task Activity Hazard Analysis (AHAs);
- vi. Lines of authority;
- vii. Policies and procedures regarding noncompliance with safety requirements (to include disciplinary actions for violation of safety requirements) should be identified;
- e. SUBCONTRACTORS AND SUPPLIERS. If applicable, provide procedures for coordinating SOH activities with other employers on the job site:
  - i. Identification of subcontractors and suppliers (if known);
  - ii. Safety responsibilities of subcontractors and suppliers.
- f. TRAINING.
  - i. Site-specific SOH orientation training at the time of initial hire or assignment to the project for every employee before working on the project site is required.
  - ii. Mandatory training and certifications that are applicable to this project (e.g., explosive actuated tools, crane operator, rigger, crane signal person, fall protection, electrical lockout/NFPA 70E, machine/equipment lockout, confined space, etc...) and any requirements for periodic retraining/recertification are required.
  - iii. Procedures for ongoing safety and health training for supervisors and employees shall be established to address changes in site hazards/conditions.
  - iv. OSHA 10-hour training is required for all workers on site and the OSHA 30-hour training is required for Trade Competent Persons (CPs)
- g. SAFETY AND HEALTH INSPECTIONS.
  - i. Specific assignment of responsibilities for a minimum daily job site safety and health inspection during periods of work activity: Who will conduct (e.g., "Site Safety and Health CP"), proof of inspector's training/qualifications, when inspections will be conducted, procedures for documentation, deficiency tracking system, and follow-up procedures.
  - ii. Any external inspections/certifications that may be required (e.g., contracted CSP or CSHT)
- h. ACCIDENT INVESTIGATION & REPORTING. The Contractor shall conduct mishap investigations of all OSHA Recordable Incidents. The APP shall include accident/incident investigation procedure & identify person(s) responsible to provide the following to the Contracting Officer Representative :
  - i. Exposure data (man-hours worked);
  - ii. Accident investigations, reports, and logs.
- i. PLANS (PROGRAMS, PROCEDURES) REQUIRED. Based on a risk assessment of contracted activities and on mandatory OSHA compliance programs, the Contractor shall address all applicable occupational risks in site-specific compliance and accident prevention plans. These Plans shall include but are not limited to procedures for addressing the risks associated with the following:
  - i. Emergency response ;

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- ii. Contingency for severe weather;
  - iii. Fire Prevention ;
  - iv. Medical Support;
  - v. Posting of emergency telephone numbers;
  - vi. Prevention of alcohol and drug abuse;
  - vii. Site sanitation (housekeeping, drinking water, toilets);
  - viii. Night operations and lighting ;
  - ix. Hazard communication program;
  - x. Welding/Cutting "Hot" work ;
  - xi. Electrical Safe Work Practices (Electrical LOTO/NFPA 70E);
  - xii. General Electrical Safety
  - xiii. Hazardous energy control (Machine LOTO);
  - xiv. Site-Specific Fall Protection & Prevention;
  - xv. Excavation/trenching;
  - xvi. Asbestos abatement;
  - xvii. Lead abatement;
  - xviii. Crane Critical lift;
  - xix. Respiratory protection;
  - xx. Health hazard control program;
  - xxi. Radiation Safety Program;
  - xxii. Abrasive blasting;
  - xxiii. Heat/Cold Stress Monitoring;
  - xxiv. Crystalline Silica Monitoring (Assessment);
  - xxv. Demolition plan (to include engineering survey);
  - xxvi. Formwork and shoring erection and removal;
  - xxvii. PreCast Concrete.
- C. Submit the APP to the Contracting Officer Representative for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES 15 calendar days prior to the start of construction for acceptance. Work cannot proceed without an accepted APP.
- D. Once accepted by the Contracting Officer Representative , the APP and attachments will be enforced as part of the contract. Disregarding the provisions of this contract or the accepted APP will be cause for stopping of work, at the discretion of the Contracting Officer, until the matter has been rectified.
- E. Once work begins, changes to the accepted APP shall be made with the knowledge and concurrence of the Contracting Officer Representative . Should any severe hazard exposure, i.e. imminent danger, become evident, stop work in the area, secure the area, and develop a plan to remove the exposure and control the hazard. Notify the Contracting Officer within 24 hours of discovery. Eliminate/remove the hazard. In the interim, take all necessary action to

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restore and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public (as defined by ASSE/SAFE A10.34) and the environment.

**1.05 ACTIVITY HAZARD ANALYSES (AHAS):**

- A. AHAs are also known as Job Hazard Analyses, Job Safety Analyses, and Activity Safety Analyses. Before beginning each work activity involving a type of work presenting hazards not experienced in previous project operations or where a new work crew or sub-contractor is to perform the work, the Contractor(s) performing that work activity shall prepare an AHA (Example electronic AHA forms can be found on the US Army Corps of Engineers web site)
  - B. AHAs shall define the activities being performed and identify the work sequences, the specific anticipated hazards, site conditions, equipment, materials, and the control measures to be implemented to eliminate or reduce each hazard to an acceptable level of risk.
  - C. Work shall not begin until the AHA for the work activity has been accepted by the Contracting Officer Representative and discussed with all engaged in the activity, including the Contractor, subcontractor(s), and Government on-site representatives at preparatory and initial control phase meetings.
- 1. The names of the Competent/Qualified Person(s) required for a particular activity (for example, excavations, scaffolding, fall protection, other activities as specified by OSHA and/or other State and Local agencies) shall be identified and included in the AHA. Certification of their competency/qualification shall be submitted to the Government Designated Authority (GDA) for acceptance prior to the start of that work activity.
  - 2. The AHA shall be reviewed and modified as necessary to address changing site conditions, operations, or change of competent/qualified person(s).
    - a. If more than one Competent/Qualified Person is used on the AHA activity, a list of names shall be submitted as an attachment to the AHA. Those listed must be Competent/Qualified for the type of work involved in the AHA and familiar with current site safety issues.
    - b. If a new Competent/Qualified Person (not on the original list) is added, the list shall be updated (an administrative action not requiring an updated AHA). The new person shall acknowledge in writing that he or she has reviewed the AHA and is familiar with current site safety issues.
  - 3. Submit AHAs to the Contracting Officer Representative for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES for review at least 15 calendar days prior to the start of each phase. Subsequent AHAs as shall be formatted as amendments to the APP. The analysis should be used during daily inspections to ensure the implementation and effectiveness of the activity's safety and health controls.
  - 4. The AHA list will be reviewed periodically (at least monthly) at the Contractor supervisory safety meeting and updated as necessary when procedures, scheduling, or hazards change.
  - 5. Develop the activity hazard analyses using the project schedule as the basis for the activities performed. All activities listed on the project schedule will require an AHA. The AHAs will be developed by the contractor, supplier, or subcontractor and provided to the prime contractor for review and approval and then submitted to the Contracting Officer Representative .

**1.06 PRECONSTRUCTION CONFERENCE:**

- A. Contractor representatives who have a responsibility or significant role in implementation of the accident prevention program, as required by 29 CFR 1926.20(b)(1), on the project shall attend the preconstruction conference to gain a mutual understanding of its implementation. This includes the project superintendent, subcontractor superintendents, and any other assigned safety and health professionals.



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- B. Discuss the details of the submitted APP to include incorporated plans, programs, procedures and a listing of anticipated AHAs that will be developed and implemented during the performance of the contract. This list of proposed AHAs will be reviewed at the conference and an agreement will be reached between the Contractor and the Contracting Officer's representative as to which phases will require an analysis. In addition, establish a schedule for the preparation, submittal, review, and acceptance of AHAs to preclude project delays.
- C. Deficiencies in the submitted APP will be brought to the attention of the Contractor within 14 days of submittal, and the Contractor shall revise the plan to correct deficiencies and re-submit it for acceptance. Do not begin work until there is an accepted APP.

#### 1.07 "SITE SAFETY AND HEALTH OFFICER" (SSHO) AND "COMPETENT PERSON" (CP):

- A. The Prime Contractor shall designate a minimum of one SSHO at each project site that will be identified as the SSHO to administer the Contractor's safety program and government-accepted Accident Prevention Plan. The SSHO may be the Contractor's Superintendent. Each subcontractor shall designate a minimum of one CP in compliance with 29 CFR 1926.20 (b)(2) that will be identified as a CP to administer their individual safety programs.
- B. Further, all specialized Competent Persons for the work crews will be supplied by the respective contractor as required by 29 CFR 1926 (i.e. Asbestos, Electrical, Cranes, & Derricks, Demolition, Fall Protection, Fire Safety/Life Safety, Ladder, Rigging, Scaffolds, and Trenches/Excavations).
- C. These Competent Persons can have collateral duties as the subcontractor's superintendent and/or work crew lead persons as well as fill more than one specialized CP role (i.e. Asbestos, Electrical, Cranes, & Derricks, Demolition, Fall Protection, Fire Safety/Life Safety, Ladder, Rigging, Scaffolds, and Trenches/Excavations).
- D. The SSHO or an equally-qualified Designated Representative/alternate will maintain a presence on the site during construction operations in accordance with FAR Clause 52.236-6: Superintendence by the Contractor. CPs will maintain presence during their construction activities in accordance with above mentioned clause. A listing of the designated SSHO and all known CPs shall be submitted prior to the start of work as part of the APP with the training documentation and/or AHA as listed in Section 1.08 below.
- E. The repeated presence of uncontrolled hazards during a contractor's work operations will result in the designated CP as being deemed incompetent and result in the required removal of the employee in accordance with FAR Clause 52.236-5: Material and Workmanship, Paragraph (c).

#### 1.08 TRAINING:

- A. The designated Prime Contractor SSHO must meet the requirements of all applicable OSHA standards and be capable (through training, experience, and qualifications) of ensuring that the requirements of 29 CFR 1926.16 and other appropriate Federal, State and local requirements are met for the project. As a minimum the SSHO must have completed the OSHA 30-hour Construction Safety class and have five (5) years of construction industry safety experience or three (3) years if he/she possesses a Certified Safety Professional (CSP) or certified Construction Safety and Health Technician (CSHT) certification or have a safety and health degree from an accredited university or college.
- B. All designated CPs shall have completed the OSHA 30-hour Construction Safety course within the past 5 years.
- C. In addition to the OSHA 30 Hour Construction Safety Course, all CPs with high hazard work operations such as operations involving asbestos, electrical, cranes, demolition, work at heights/fall protection, fire safety/life safety, ladder, rigging, scaffolds, and trenches/excavations shall have a specialized formal course in the hazard recognition & control associated with those

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high hazard work operations. Documented "repeat" deficiencies in the execution of safety requirements will require retaking the requisite formal course.

- D. All other construction workers shall have the OSHA 10-hour Construction Safety Outreach course and any necessary safety training to be able to identify hazards within their work environment.
- E. Submit training records associated with the above training requirements to the Contracting Officer Representative for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES 15 calendar days prior to the date of the start of construction for acceptance.
- F. Prior to any worker for the contractor or subcontractors beginning work, they shall undergo a safety briefing provided by the SSHO or his/her designated representative. As a minimum, this briefing shall include information on the site-specific hazards, construction limits, VAMC safety guidelines, means of egress, break areas, work hours, locations of restrooms, use of VAMC equipment, emergency procedures, accident reporting etc... Documentation shall be provided to the Contracting Officer Representative that individuals have undergone contractor's safety briefing.
- G. Ongoing safety training will be accomplished in the form of weekly documented safety meeting.

**1.09 INSPECTIONS:**

- A. The SSHO shall conduct frequent and regular safety inspections (daily) of the site and each of the subcontractors CPs shall conduct frequent and regular safety inspections (daily) of their work operations as required by 29 CFR 1926.20(b)(2). Each week, the SSHO shall conduct a formal documented inspection of the entire construction areas with the subcontractors' "Trade Safety and Health CPs" present in their work areas. Coordinate with, and report findings and corrective actions weekly to Contracting Officer Representative .

**1.10 ACCIDENTS, OSHA 300 LOGS, AND MAN-HOURS:**

- A. Notify the Contracting Officer Representative as soon as practical, but no more than four hours after any accident meeting the definition of OSHA Recordable Injuries or Illnesses or High Visibility Accidents, property damage equal to or greater than \$5,000, or any weight handling equipment accident. Within notification include contractor name; contract title; type of contract; name of activity, installation or location where accident occurred; date and time of accident; names of personnel injured; extent of property damage, if any; extent of injury, if known, and brief description of accident (to include type of construction equipment used, PPE used, etc.). Preserve the conditions and evidence on the accident site until the Contracting Officer Representative determine whether a government investigation will be conducted.
- B. Conduct an accident investigation for recordable injuries and illnesses, for Medical Treatment defined in paragraph DEFINITIONS, and property damage accidents resulting in at least \$20,000 in damages, to establish the root cause(s) of the accident. Complete the VA Form 2162, and provide the report to the Contracting Officer Representative within 5 calendar days of the accident. The Contracting Officer Representative will provide copies of any required or special forms.
- C. A summation of all man-hours worked by the contractor and associated sub-contractors for each month will be reported to the Contracting Officer Representative monthly.
- D. A summation of all OSHA recordable accidents experienced on site by the contractor and associated sub-contractors for each month will be provided to the Contracting Officer Representative monthly. The contractor and associated sub-contractors' OSHA 300 logs will be made available to the Contracting Officer Representative as requested.

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**1.11 PERSONAL PROTECTIVE EQUIPMENT (PPE):**

A. PPE is governed in all areas by the nature of the work the employee is performing. For example, specific PPE required for performing work on electrical equipment is identified in NFPA 70E, Standard for Electrical Safety in the Workplace.

B. Mandatory PPE includes:

1. Hard Hats – unless written authorization is given by the Contracting Officer Representative in circumstances of work operations that have limited potential for falling object hazards such as during finishing work or minor remodeling. With authorization to relax the requirement of hard hats, if a worker becomes exposed to an overhead falling object hazard, then hard hats would be required in accordance with the OSHA regulations.
2. Safety glasses - unless written authorization is given by the Contracting Officer Representative appropriate safety glasses meeting the ANSI Z.87.1 standard must be worn by each person on site.
3. Appropriate Safety Shoes – based on the hazards present, safety shoes meeting the requirements of ASTM F2413-11 shall be worn by each person on site unless written authorization is given by the Contracting Officer Representative .
4. Hearing protection - Use personal hearing protection at all times in designated noise hazardous areas or when performing noise hazardous tasks.

**1.12 INFECTION CONTROL**

A. Infection Control is critical in all medical center facilities. Interior construction activities causing disturbance of existing dust, or creating new dust, must be conducted within ventilation-controlled areas that minimize the flow of airborne particles into patient areas. Exterior construction activities causing disturbance of soil or creates dust in some other manner must be controlled.

B. An AHA associated with infection control will be performed by VA personnel in accordance with FGI Guidelines (i.e. Infection Control Risk Assessment (ICRA)). The ICRA procedure found on the American Society for Healthcare Engineering (ASHE) website will be utilized. Risk classifications of Class II or lower will require approval by the Contracting Officer Representative before beginning any construction work. Risk classifications of Class III or higher will require a permit before beginning any construction work. Infection Control permits will be issued by the Contracting Officer Representative . The Infection Control Permits will be posted outside the appropriate construction area. More than one permit may be issued for a construction project if the work is located in separate areas requiring separate classes. The primary project scope area for this project is III as shown on the approved Infection Control Safety Construction Permit(s) (ICRA), however, work outside the primary project scope area may vary. The required infection control precautions with each class are as follows:

1. Class I requirements:

a. During Construction Work:

- i. Notify the Contracting Officer Representative
- ii. Execute work by methods to minimize raising dust from construction operations.
- iii. Ceiling tiles: Immediately replace a ceiling tiles displaced for visual inspection.

b. Upon Completion:

- i. Clean work area upon completion of task
- ii. Notify the Contracting Officer Representative

2. Class II requirements:

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- a. During Construction Work:
    - i. Notify the Contracting Officer Representative
    - ii. Provide active means to prevent airborne dust from dispersing into atmosphere such as wet methods or tool mounted dust collectors where possible.
    - iii. Water mist work surfaces to control dust while cutting.
    - iv. Seal unused doors with duct tape.
    - v. Block off and seal air vents.
    - vi. Remove or isolate HVAC system in areas where work is being performed.
  - b. Upon Completion:
    - i. Wipe work surfaces with cleaner/disinfectant.
    - ii. Contain construction waste before transport in tightly covered containers.
    - iii. Wet mop and/or vacuum with HEPA filtered vacuum before leaving work area.
    - iv. Upon completion, restore HVAC system where work was performed
    - v. Notify the Contracting Officer Representative
3. Class III requirements:
- a. During Construction Work:
    - i. Obtain permit from the Contracting Officer Representative
    - ii. Remove or Isolate HVAC system in area where work is being done to prevent contamination of duct system.
    - iii. Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. Install construction barriers and ceiling protection carefully, outside of normal work hours.
    - iv. Maintain negative air pressure, 0.01 inches of water gauge, within work site utilizing HEPA equipped air filtration units and continuously monitored with a digital display, recording and alarm instrument, which must be calibrated on installation, maintained with periodic calibration and monitored by the contractor.
    - v. Contain construction waste before transport in tightly covered containers.
    - vi. Cover transport receptacles or carts. Tape covering unless solid lid.
  - b. Upon Completion:
    - i. Do not remove barriers from work area until completed project is inspected by the Contracting Officer Representative and thoroughly cleaned by the VA Environmental Services Department.
    - ii. Remove construction barriers and ceiling protection carefully to minimize spreading of dirt and debris associated with construction, outside of normal work hours.
    - iii. Vacuum work area with HEPA filtered vacuums.
    - iv. Wet mop area with cleaner/disinfectant.
    - v. Upon completion, restore HVAC system where work was performed.

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- vi. Return permit to the Contracting Officer Representative

4. Class IV requirements:

a. During Construction Work:

- i. Obtain permit from the Contracting Officer Representative
- ii. Isolate HVAC system in area where work is being done to prevent contamination of duct system.
- iii. Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. Install construction barriers and ceiling protection carefully, outside of normal work hours.
- iv. Maintain negative air pressure within work site utilizing HEPA equipped air filtration units.
- v. Seal holes, pipes, conduits, and punctures.
- vi. Construct anteroom and require all personnel to pass through this room so they can be vacuumed using a HEPA vacuum cleaner before leaving work site or they can wear cloth or paper coveralls that are removed each time they leave work site.
- vii. All personnel entering work site are required to wear shoe covers. Shoe covers must be changed each time the worker exits the work area.

b. Upon Completion:

- i. Do not remove barriers from work area until completed project is inspected by the Contracting Officer Representative with thorough cleaning by the VA Environmental Services Dept.
- ii. Remove construction barriers and ceiling protection carefully to minimize spreading of dirt and debris associated with construction, outside of normal work hours.
- iii. Contain construction waste before transport in tightly covered containers.
- iv. Cover transport receptacles or carts. Tape covering unless solid lid.
- v. Vacuum work area with HEPA filtered vacuums.
- vi. Wet mop area with cleaner/disinfectant.
- vii. Upon completion, restore HVAC system where work was performed.
- viii. Return permit to the Contracting Officer Representative

C. Barriers shall be erected as required based upon classification (Class III & IV requires barriers) and shall be constructed as follows:

1. Class III and IV - closed door with masking tape applied over the frame and door is acceptable for projects that can be contained in a single room.
2. Construction, demolition or reconstruction not capable of containment within a single room must have the following barriers erected and made presentable on hospital occupied side:
  - a. Class III & IV (where dust control is the only hazard, and an agreement is reached with the COR and Medical Center) - Airtight fire retardant sheet plastic barrier that extends from the floor to ceiling. Seams must be sealed with duct tape to prevent dust and debris from escaping

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- b. Class III & IV - Drywall barrier erected with joints covered or sealed to prevent dust and debris from escaping.
- c. Class III & IV - Seal all penetrations in existing barrier airtight
- d. Class III & IV - Barriers at penetration of ceiling envelopes, chases and ceiling spaces to stop movement air and debris
- e. Class IV only - Anteroom or double entrance openings that allow workers to remove protective clothing or vacuum off existing clothing
- f. Class III & IV - At elevators shafts or stairways within the field of construction, overlapping flap minimum of two feet wide of fire retardant sheet plastic enclosures for personnel access.

## D. Products and Materials:

1. Sheet Plastic: Fire retardant polystyrene, 6-mil thickness or greater meeting local fire codes, may be used where dust control is the only hazard, and an agreement is reached with the COR
2. Barrier Doors: Self Closing Two-hour fire-rated solid core wood in steel frame, painted
3. Dust proof two-hour fire-rated drywall
4. High Efficiency Particulate Air-Equipped filtration machine rated at 95% capture of 0.3 microns including pollen, mold spores and dust particles. HEPA filters should have ASHRAE 85 or other prefilter to extend the useful life of the HEPA. Provide both primary and secondary filtrations units. Maintenance of equipment and replacement of the HEPA filters and other filters will be in accordance with manufacturer's instructions.
5. Exhaust Hoses: Heavy duty, flexible steel reinforced; Ventilation Blower Hose
6. Adhesive Walk-off Mats: Provide minimum size mats of 24 inches x 36 inches
7. Disinfectant: Hospital-approved disinfectant or equivalent product
8. Portable Ceiling Access Module

E. Before any construction on site begins, all contractor personnel involved in the construction or renovation activity shall be educated and trained in infection prevention measures established by the medical center.

F. A dust control program will be establish and maintained as part of the contractor's infection preventive measures in accordance with the FGI Guidelines for Design and Construction of Healthcare Facilities. Prior to start of work, prepare a plan detailing project-specific dust protection measures with associated product data, including periodic status reports, and submit to Contracting Officer Representative for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

G. Medical center Infection Control personnel shall at their discretion have access to the site to monitor for airborne disease (e.g. aspergillosis) during construction. A baseline of conditions may be established by the medical center prior to the start of work and periodically during the construction stage to determine impact of construction activities on indoor air quality with safe thresholds established.

H. In general, the following preventive measures shall be adopted during construction to keep down dust and prevent mold.

1. Contractor shall verify that construction exhaust to exterior is not reintroduced to the medical center through intake vents, or building openings. HEPA filtration is required where the exhaust dust may reenter the medical center.
2. Exhaust hoses shall be exhausted so that dust is not reintroduced to the medical center.

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3. Adhesive Walk-off/Carpet Walk-off Mats shall be used at all interior transitions from the construction area to occupied medical center area. These mats shall be changed as often as required to maintain clean work areas directly outside construction area at all times.

4. Vacuum and wet mop all transition areas from construction to the occupied medical center at the end of each workday. Vacuum shall utilize HEPA filtration. Maintain surrounding area frequently. Remove debris as it is created. Transport these outside the construction area in containers with tightly fitting lids.

5. The contractor shall not haul debris through patient-care areas without prior approval of the Contracting Officer Representative and the Medical Center. When, approved, debris shall be hauled in enclosed dust proof containers or wrapped in plastic and sealed with duct tape. No sharp objects should be allowed to cut through the plastic. Wipe down the exterior of the containers with a damp rag to remove dust. All equipment, tools, material, etc. transported through occupied areas shall be made free from dust and moisture by vacuuming and wipe down.

6. There shall be no standing water during construction. This includes water in equipment drip pans and open containers within the construction areas. All accidental spills must be cleaned up and dried within 12 hours. Remove and dispose of porous materials that remain damp for more than 72 hours.

7. At completion, remove construction barriers and ceiling protection carefully, outside of normal work hours. Vacuum and clean all surfaces free of dust after the removal.

I. Final Cleanup:

1. Upon completion of project, or as work progresses, remove all construction debris from above ceiling, vertical shafts and utility chases that have been part of the construction.

2. Perform HEPA vacuum cleaning of all surfaces in the construction area. This includes walls, ceilings, cabinets, furniture (built-in or free standing), partitions, flooring, etc.

3. All new air ducts shall be cleaned prior to final inspection.

J. Exterior Construction

1. Contractor shall verify that dust will not be introduced into the medical center through intake vents, or building openings. HEPA filtration on intake vents is required where dust may be introduced.

2. Dust created from disturbance of soil such as from vehicle movement will be wetted with use of a water truck as necessary

3. All cutting, drilling, grinding, sanding, or disturbance of materials shall be accomplished with tools equipped with either local exhaust ventilation (i.e. vacuum systems) or wet suppression controls.

**1.13 NOT APPLICABLE**

**1.14 FIRE SAFETY**

A. Fire Safety Plan: Establish and maintain a site-specific fire protection program in accordance with 29 CFR 1926. Prior to start of work, prepare a plan detailing project-specific fire safety measures, including periodic status reports, and submit to Contracting Officer Representative for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES. This plan may be an element of the Accident Prevention Plan.

B. Site and Building Access: Maintain free and unobstructed access to facility emergency services and for fire, police and other emergency response forces in accordance with NFPA 241.

C. Separate temporary facilities, such as trailers, storage sheds, and dumpsters, from existing buildings and new construction by distances in accordance with NFPA 241. For small facilities with less than 6 m (20 feet) exposing overall length, separate by 3m (10 feet).

D. Temporary Construction Partitions:

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1. Install and maintain temporary construction partitions to provide smoke-tight separations between construction areas, , and adjoining areas. Construct partitions of gypsum board or treated plywood (flame spread rating of 25 or less in accordance with ASTM E84) on both sides of fire retardant treated wood or metal steel studs. Extend the partitions through suspended ceilings to floor slab deck or roof. Seal joints and penetrations. At door openings, install Class C, ¾ hour fire/smoke rated doors with self-closing devices.
2. Install two-hour fire-rated temporary construction partitions to maintain integrity of existing exit stair enclosures, exit passageways, fire-rated enclosures of hazardous areas, horizontal exits, smoke barriers, vertical shafts and openings enclosures.
3. Close openings in smoke barriers and fire-rated construction to maintain fire ratings. Seal penetrations with listed through-penetration firestop materials in accordance with Section 07 84 00, FIRESTOPPING.
  - E. Temporary Heating and Electrical: Install, use and maintain installations in accordance with 29 CFR 1926, NFPA 241 and NFPA 70. Use of Temporary Heating requires approval in writing by the Chillicothe VAMC Fire Department. Submit temporary heating plan for approval. Coordinate with the Contracting Officer Representative.
  - F. Means of Egress: Do not block exiting for occupied buildings, including paths from exits to roads. Minimize disruptions and coordinate with Contracting Officer Representative.
  - G. Egress Routes for Construction Workers: Maintain free and unobstructed egress. Inspect daily. Report findings and corrective actions weekly to Contracting Officer Representative .
  - H. Fire Extinguishers: Provide and maintain extinguishers in construction areas and temporary storage areas in accordance with 29 CFR 1926, NFPA 241 and NFPA 10.
  - I. Flammable and Combustible Liquids: Store, dispense and use liquids in accordance with 29 CFR 1926, NFPA 241 and NFPA 30.
  - J. Standpipes: Install and extend standpipes up with each floor in accordance with 29 CFR 1926 and NFPA 241. Do not charge wet standpipes subject to freezing until weather protected.
  - K. Sprinklers: Install, test and activate new automatic sprinklers prior to removing existing sprinklers.
  - L. Existing Fire Protection: Do not impair automatic sprinklers, smoke and heat detection, and fire alarm systems, except for portions immediately under construction, and temporarily for connections. Provide fire watch for impairments more than 4 hours in a 24-hour period. Request interruptions in accordance with Article, OPERATIONS AND STORAGE AREAS, and coordinate with Contracting Officer Representative . All existing or temporary fire protection systems (fire alarms, sprinklers) located in construction areas shall be tested as coordinated with the medical center. Parameters for the testing and results of any tests performed shall be recorded by the medical center and copies provided to the Contracting Officer Representative .
  - M. Smoke Detectors: Prevent accidental operation. Remove temporary covers at end of work operations each day. Coordinate with Contracting Officer Representative .
  - N. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B , and the Chillicothe VAMC Station Standard Operating Procedure on Hot Work . Coordinate with Contracting Officer Representative . Obtain permits per the Chillicothe VAMC Station Standard Operating Procedure on Hot Work before performing any hot work .
  - O. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and corrective actions weekly to Contracting Officer Representative .



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- P. Smoking: Smoking is prohibited in and adjacent to construction areas inside existing buildings and additions under construction. In separate and detached buildings under construction, smoking is prohibited except in designated smoking rest areas.
- Q. Dispose of waste and debris in accordance with NFPA 241. Remove from buildings daily.
- R. If required, submit documentation to the Contracting Officer Representative that personnel have been trained in the fire safety aspects of working in areas with impaired structural or compartmentalization features.

#### 1.15 ELECTRICAL

- A. All electrical work shall comply with NFPA 70 (NEC), NFPA 70B, NFPA 70E, 29 CFR Part 1910 Subpart J – General Environmental Controls, 29 CFR Part 1910 Subpart S – Electrical, and 29 CFR 1926 Subpart K in addition to other references required by contract.
- B. All qualified persons performing electrical work under this contract shall be licensed journeyman or master electricians. All apprentice electricians performing under this contract shall be deemed unqualified persons unless they are working under the immediate supervision of a licensed electrician or master electrician.
- C. All electrical work will be accomplished de-energized and in the Electrically Safe Work Condition (refer to NFPA 70E for Work Involving Electrical Hazards, including Exemptions to Work Permit). Any Contractor, subcontractor or temporary worker who fails to fully comply with this requirement is subject to immediate termination in accordance with FAR clause 52.236-5(c). Only in rare circumstance where achieving an electrically safe work condition prior to beginning work would increase or cause additional hazards, or is infeasible due to equipment design or operational limitations is energized work permitted. The Contracting Officer Representative with approval of the Medical Center Director will make the determination if the circumstances would meet the exception outlined above. An AHA specific to energized work activities will be developed, reviewed, and accepted prior to the start of that work.
  - 1. Development of a Hazardous Electrical Energy Control Procedure is required prior to de-energization. A single Simple Lockout/Tagout Procedure for multiple work operations can only be used for work involving qualified person(s) de-energizing one set of conductors or circuit part source. Task specific Complex Lockout/Tagout Procedures are required at all other times.
  - 2. Verification of the absence of voltage after de-energization and lockout/tagout is considered “energized electrical work” (live work) under NFPA 70E, and shall only be performed by qualified persons wearing appropriate shock protective (voltage rated) gloves and arc rated personal protective clothing and equipment, using Underwriters Laboratories (UL) tested and appropriately rated contact electrical testing instruments or equipment appropriate for the environment in which they will be used.
  - 3. Personal Protective Equipment (PPE) and electrical testing instruments will be readily available for inspection by the Contracting Officer Representative.
- D. Before beginning any electrical work, an Activity Hazard Analysis (AHA) will be conducted to include Shock Hazard and Arc Flash Hazard analyses (NFPA Tables can be used only as a last alternative and it is strongly suggested a full Arc Flash Hazard Analysis be conducted). Work shall not begin until the AHA for the work activity has been accepted by the Contracting Officer Representative and discussed with all engaged in the activity, including the Contractor, subcontractor(s), and Government on-site representatives at preparatory and initial control phase meetings.
- E. Ground-fault circuit interrupters. All 120-volt, single-phase 15- and 20-ampere receptacle outlets on construction sites shall have approved ground-fault circuit interrupters for personnel protection. “Assured Equipment Grounding Conductor Program” only is not allowed.

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**1.16 FALL PROTECTION**

The fall protection (FP) threshold height requirement is 6 ft (1.8 m) for ALL WORK, unless specified differently or the OSHA 29 CFR 1926 requirements are more stringent, to include steel erection activities, systems-engineered activities (prefabricated) metal buildings, residential (wood) construction and scaffolding work.

- A. The use of a Safety Monitoring System (SMS) as a fall protection method is prohibited.
- B. The use of Controlled Access Zone (CAZ) as a fall protection method is prohibited.
- C. A Warning Line System (WLS) may ONLY be used on floors or flat or low-sloped roofs (between 0 - 18.4 degrees or 4:12 slope) and shall be erected around all sides of the work area (See 29 CFR 1926.502(f) for construction of WLS requirements). Working within the WLS does not require FP. No worker shall be allowed in the area between the roof or floor edge and the WLS without FP. FP is required when working outside the WLS.
- D. Fall protection while using a ladder will be governed by the OSHA requirements.

**1.17 SCAFFOLDS AND OTHER WORK PLATFORMS**

- A. All scaffolds and other work platforms construction activities shall comply with 29 CFR 1926 Subpart L.
- B. The fall protection (FP) threshold height requirement is 6 ft (1.8 m) as stated in Section 1.16.
- C. The following hierarchy and prohibitions shall be followed in selecting appropriate work platforms.
  - 1. Scaffolds, platforms, or temporary floors shall be provided for all work except that can be performed safely from the ground or similar footing.
  - 2. Ladders less than 20 feet may be used as work platforms only when use of small hand tools or handling of light material is involved.
  - 3. Ladder jacks, lean-to, and prop-scaffolds are prohibited.
  - 4. Emergency descent devices shall not be used as working platforms.
- D. Contractors shall use a scaffold tagging system in which all scaffolds are tagged by the Competent Person. Tags shall be color-coded: green indicates the scaffold has been inspected and is safe to use; red indicates the scaffold is unsafe to use. Tags shall be readily visible, made of materials that will withstand the environment in which they are used, be legible and shall include:
  - 1. The Competent Person's name and signature;
  - 2. Dates of initial and last inspections.
- E. Mast Climbing work platforms: When access ladders, including masts designed as ladders, exceed 20 ft (6 m) in height, positive fall protection shall be used.

**1.18 EXCAVATION AND TRENCHES**

- A. All excavation and trenching work shall comply with 29 CFR 1926 Subpart P , and the Chillicothe VAMC Standard Operating Procedure on Excavation and Trenching .
- B. All excavations and trenches 5 feet in depth or greater shall require a written trenching and excavation permit (NOTE – some States and other local jurisdictions require separate state/jurisdiction-issued excavation permits). The permit shall be completed and provided to the Contracting Officer Representative prior to commencing work. The permit shall be maintained onsite and include the following:
  - 1. Determination of soil classification

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2. Indication that utilities have been located and identified. If utilities could not be located after all reasonable attempt, then excavating operations will proceed cautiously.
3. Indication of selected excavation protective system.
4. Indication that the spoil pile will be stored at least 2 feet from the edge of the excavation and safe access provided within 25 feet of the workers.
5. Indication of assessment for a potential toxic, explosive, or oxygen deficient atmosphere.
6. Map, Drawing, or Sketch showing a minimum 10' beyond the extents of the excavation, spatially recognizable by building or road features.

If the above location or conditions change to a more hazardous condition than described on the original permit, particularly when additional precautions would be required, the approved permit shall become invalid, and a new permit shall be submitted. There is not a standardized Chillicothe VAMC Excavation Permit, and thus the excavation permit shall be submitted as a letter from the Contractor on their Company Letterhead for acceptance by the Government.

- C. If not using an engineered protective system such as a trench box, shielding, shoring, or other Professional Engineer designed system and using a sloping or benching system, soil classification cannot be Solid Rock or Type A. All soil will be classified as Type C and sloped in accordance with Appendix B of 29 CFR 1926 ; any exceptions are certified in writing by a registered professional engineer (PE).

**1.19 CRANES**

- A. All crane work shall comply with 29 CFR 1926 Subpart CC.
- B. Prior to operating a crane, the operator must be licensed, qualified or certified to operate the crane. Thus, all the provisions contained with Subpart CC are effective and there is no "Phase In" date of November 10, 2014.
- C. A detailed lift permit shall be submitted to the Contracting Officer Representative 14 days prior to the scheduled lift complete with route for truck carrying load, crane load analysis, siting of crane and path of swing. The lift will not be allowed without approval of this document.
- D. Crane operators shall not carry loads
  1. over the general public or VAMC personnel
  2. over any occupied building unless
    - a. the top two floors are vacated
    - b. or overhead protection with a design live load of 300 psf is provided

**1.20 CONTROL OF HAZARDOUS ENERGY (LOCKOUT/TAGOUT)**

- A. All installation, maintenance, and servicing of equipment or machinery shall comply with 29 CFR 1910.147 except for specifically referenced operations in 29 CFR 1926 such as concrete & masonry equipment [1926.702(j)], heavy machinery & equipment [1926.600(a)(3)(i)], and process safety management of highly hazardous chemicals (1926.64). Control of hazardous electrical energy during the installation, maintenance, or servicing of electrical equipment shall comply with Section 1.15 to include NFPA 70E and other VA specific requirements discussed in the section.
- B. Contractor shall submit their LOCKOUT/TAGOUT written procedures to the Chillicothe VAMC. These procedures are shared with the Construction Safety Working Group and Engineering Employees to ensure they know the Contractor's LOCKOUT/TAGOUT procedures.

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**1.21 CONFINED SPACE ENTRY**

- A. All confined space entry shall comply with 29 CFR 1910.146 except for specifically referenced operations in 29 CFR 1926 such as excavations/trenches [1926.651(g)]In addition, the Chillicothe VAMC station Standard Operating Procedure on Confined Space Entry, or the Contractor's Confined Space Entry Procedure shall be followed.
- B. A site-specific Confined Space Entry Plan (including permitting process) shall be developed and submitted to the Contracting Officer Representative.

**1.22 WELDING AND CUTTING**

As specified in section FIRE SAFETY, Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B , and the Chillicothe VAMC Station Standard Operating Procedure on Hot Work . Coordinate with Contracting Officer Representative . Obtain permits per the Chillicothe VAMC Station Standard Operating Procedure on Hot Work before performing any hot work .

**1.23 LADDERS**

- A. All Ladder use shall comply with 29 CFR 1926 Subpart X.
  - B. All portable ladders shall be of sufficient length and shall be placed so that workers will not stretch or assume a hazardous position.
  - C. Manufacturer safety labels shall be in place on ladders
  - D. Step Ladders shall not be used in the closed position
  - E. Top steps or cap of step ladders shall not be used as a step
  - F. Portable ladders, used as temporary access, shall extend at least 3 ft (0.9 m) above the upper landing surface.
1. When a 3 ft (0.9-m) extension is not possible, a grasping device (such as a grab rail) shall be provided to assist workers in mounting and dismounting the ladder.
  2. In no case shall the length of the ladder be such that ladder deflection under a load would, by itself, cause the ladder to slip from its support.
- G. Ladders shall be inspected for visible defects on a daily basis and after any occurrence that could affect their safe use. Broken or damaged ladders shall be immediately tagged "DO NOT USE," or with similar wording, and withdrawn from service until restored to a condition meeting their original design.

**1.24 FLOOR & WALL OPENINGS**

- A. All floor and wall openings shall comply with 29 CFR 1926 Subpart M.
  - B. Floor and roof holes/openings are any that measure over 2 in (51 mm) in any direction of a walking/working surface which persons may trip or fall into or where objects may fall to the level below. See 21.F for covering and labeling requirements. Skylights located in floors or roofs are considered floor or roof hole/openings.
  - C. All floor, roof openings or hole into which a person can accidentally walk or fall through shall be guarded either by a railing system with toeboards along all exposed sides or a load-bearing cover. When the cover is not in place, the opening or hole shall be protected by a removable guardrail system or shall be attended when the guarding system has been removed, or other fall protection system.
1. Covers shall be capable of supporting, without failure, at least twice the weight of the worker, equipment and material combined.

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2. Covers shall be secured when installed, clearly marked with the word "HOLE", "COVER" or "Danger, Roof Opening-Do Not Remove" or color-coded or equivalent methods (e.g., red or orange "X"). Workers must be made aware of the meaning for color coding and equivalent methods.
3. Roofing material, such as roofing membrane, insulation or felts, covering or partly covering openings or holes, shall be immediately cut out. No hole or opening shall be left unattended unless covered.
4. Non-load-bearing skylights shall be guarded by a load-bearing skylight screen, cover, or railing system along all exposed sides.
5. Workers are prohibited from standing/walking on skylights.

**1.25 ASBESTOS AWARENESS**

- A. The Chillicothe VA Medical Center maintains a database of known locations of Asbestos Containing Materials (ACMs). This information is available to the contractor upon request to the Contracting Officer Representative. In addition the contractor is advised that, at the time most of the buildings at this facility were constructed, ACMs were widely used in the construction industry for a broad range of applications. Through numerous abatement projects much of the ACM has been removed, but not yet all.
- B. Efforts have been made by the VA to identify the presence of any remaining ACMs in the construction work area. However, the contractor shall remain alert to the possibility that there could be ACMs present in locations not readily accessible prior to the start of construction. If during the course of his work the contractor identifies a building product or other substance which he has reason to believe could be an ACM, he is to immediately stop any and all work as necessary to avoid disturbing said material and contact the Contracting Officer Representative for a determination.

**PART 2 - PRODUCTS (Not Used)****PART 3 - EXECUTION (Not Used)**

--- END OF SECTION – SAFETY REQUIREMENTS ---

MRI TRAILER SITE PREP  
VAMC CHILLICOTHE, OHIO

SAFETY REQUIREMENTS

**SECTION 01 42 19  
REFERENCE STANDARDS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies the availability and source of references and standards specified in the project manual under paragraphs APPLICABLE PUBLICATIONS and/or shown on the drawings.

**1.2 AVAILABILITY OF SPECIFICATIONS LISTED IN THE GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS FPMR PART 101-29 (FAR 52.211-1) (AUG 1998)**

- A. The GSA Index of Federal Specifications, Standards and Commercial Item Descriptions, FPMR Part 101-29 and copies of specifications, standards, and commercial item descriptions cited in the solicitation may be obtained for a fee by submitting a request to – GSA Federal Supply Service, Specifications Section, Suite 8100, 470 East L'Enfant Plaza, SW, Washington, DC 20407, Telephone (202) 619-8925, Facsimile (202) 619-8978.
- B. If the General Services Administration, Department of Agriculture, or Department of Veterans Affairs issued this solicitation, a single copy of specifications, standards, and commercial item descriptions cited in this solicitation may be obtained free of charge by submitting a request to the addressee in paragraph (a) of this provision. Additional copies will be issued for a fee.

**1.3 AVAILABILITY FOR EXAMINATION OF SPECIFICATIONS NOT LISTED IN THE GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS (FAR 52.211-4) (JUN 1988)**

The specifications and standards cited in this solicitation can be examined at the following location:

DEPARTMENT OF VETERANS AFFAIRS  
Office of Construction & Facilities Management  
Facilities Quality Service (00CFM1A)  
425 Eye Street N.W, (sixth floor)  
Washington, DC 20001  
Telephone Numbers: (202) 632-5249 or (202) 632-5178  
Between 9:00 AM - 3:00 PM

**1.4 AVAILABILITY OF SPECIFICATIONS NOT LISTED IN THE GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS (FAR 52.211-3) (JUN 1988)**

The specifications cited in this solicitation may be obtained from the associations or organizations listed below.

AA	Aluminum Association Inc. <a href="http://www.aluminum.org">http://www.aluminum.org</a>
AABC	Associated Air Balance Council <a href="http://www.aabchg.com">http://www.aabchg.com</a>
AAMA	American Architectural Manufacturer's Association <a href="http://www.aamanet.org">http://www.aamanet.org</a>
AAN	American Nursery and Landscape Association <a href="http://www.anla.org">http://www.anla.org</a>
AASHTO	American Association of State Highway and Transportation Officials <a href="http://www.aashto.org">http://www.aashto.org</a>
AATCC	American Association of Textile Chemists and Colorists <a href="http://www.aatcc.org">http://www.aatcc.org</a>
ACGIH	American Conference of Governmental Industrial Hygienists <a href="http://www.acgih.org">http://www.acgih.org</a>
ACI	American Concrete Institute <a href="http://www.aci-int.net">http://www.aci-int.net</a>
ACPA	American Concrete Pipe Association <a href="http://www.concrete-pipe.org">http://www.concrete-pipe.org</a>
ACPPA	American Concrete Pressure Pipe Association <a href="http://www.acppa.org">http://www.acppa.org</a>
ADC	Air Diffusion Council <a href="http://flexibleduct.org">http://flexibleduct.org</a>
AGA	American Gas Association <a href="http://www.agas.org">http://www.agas.org</a>
AGC	Associated General Contractors of America <a href="http://www.agc.org">http://www.agc.org</a>
AGMA	American Gear Manufacturers Association, Inc. <a href="http://www.agma.org">http://www.agma.org</a>
AHAM	Association of Home Appliance Manufacturers <a href="http://www.aham.org">http://www.aham.org</a>



AIA American Institute of Architects

<http://www.aia.org>

AISC American Institute of Steel Construction

<http://www.aisc.org>

AISI American Iron and Steel Institute

<http://www.steel.org>

AITC American Institute of Timber Construction

<http://www.aitc-glulam.org>

AMCA Air Movement and Control Association, Inc.

<http://www.amca.org>

ANLA American Nursery & Landscape Association

<http://www.anla.org>

ANSI American National Standards Institute, Inc.

<http://www.ansi.org>

APA The Engineered Wood Association

<http://www.apawood.org>

ARI Air-Conditioning and Refrigeration Institute

<http://www.ari.org>

ASAE American Society of Agricultural Engineers

<http://www.asae.org>

ASCE American Society of Civil Engineers

<http://www.asce.org>

ASHRAE American Society of Heating, Refrigerating, and  
Air-Conditioning Engineers

<http://www.ashrae.org>

ASME American Society of Mechanical Engineers

<http://www.asme.org>

ASSE American Society of Sanitary Engineering

<http://www.asse-plumbing.org>

ASTM	American Society for Testing and Materials <a href="http://www.astm.org">http://www.astm.org</a>
AWI	Architectural Woodwork Institute <a href="http://www.awinet.org">http://www.awinet.org</a>
AWS	American Welding Society <a href="http://www.aws.org">http://www.aws.org</a>
AWWA	American Water Works Association <a href="http://www.awwa.org">http://www.awwa.org</a>
BHMA	Builders Hardware Manufacturers Association <a href="http://www.buildershardware.com">http://www.buildershardware.com</a>
BIA Brick Institute of America	<a href="http://www.bia.org">http://www.bia.org</a>
CAGI	Compressed Air and Gas Institute <a href="http://www.cagi.org">http://www.cagi.org</a>
CGA	Compressed Gas Association, Inc. <a href="http://www.cganet.com">http://www.cganet.com</a>
CI	The Chlorine Institute, Inc. <a href="http://www.chlorineinstitute.org">http://www.chlorineinstitute.org</a>
CISCA	Ceilings and Interior Systems Construction Association <a href="http://www.cisca.org">http://www.cisca.org</a>
CISPI	Cast Iron Soil Pipe Institute <a href="http://www.cispi.org">http://www.cispi.org</a>
CLFMI	Chain Link Fence Manufacturers Institute <a href="http://www.chainlinkinfo.org">http://www.chainlinkinfo.org</a>
CPMB	Concrete Plant Manufacturers Bureau <a href="http://www.cpmc.org">http://www.cpmc.org</a>
CRA	California Redwood Association <a href="http://www.calredwood.org">http://www.calredwood.org</a>
CRSI	Concrete Reinforcing Steel Institute <a href="http://www.crsi.org">http://www.crsi.org</a>

CTI Cooling Technology Institute

<http://www.cti.org>

DHI Door and Hardware Institute

<http://www.dhi.org>

EGSA Electrical Generating Systems Association

<http://www.egsa.org>

EEI Edison Electric Institute

<http://www.eei.org>

EPA Environmental Protection Agency

<http://www.epa.gov>

ETL ETL Testing Laboratories, Inc.

<http://www.et1.com>

FAA Federal Aviation Administration

<http://www.faa.gov>

FCC Federal Communications Commission

<http://www.fcc.gov>

FPS The Forest Products Society

<http://www.forestprod.org>

GANA Glass Association of North America

<http://www.cssinfo.com/info/gana.html/>

FM Factory Mutual Insurance

<http://www.fmglobal.com>

GA Gypsum Association

<http://www.gypsum.org>

GSA General Services Administration

<http://www.gsa.gov>

HI Hydraulic Institute

<http://www.pumps.org>

HPVA Hardwood Plywood & Veneer Association

<http://www.hpva.org>

ICBO	International Conference of Building Officials <a href="http://www.icbo.org">http://www.icbo.org</a>
ICEA	Insulated Cable Engineers Association Inc. <a href="http://www.icea.net">http://www.icea.net</a>
ICAC	Institute of Clean Air Companies <a href="http://www.icac.com">http://www.icac.com</a>
IEEE	Institute of Electrical and Electronics Engineers <a href="http://www.ieee.org">http://www.ieee.org</a>
IMSA	International Municipal Signal Association <a href="http://www.imsasafety.org">http://www.imsasafety.org</a>
IPCEA	Insulated Power Cable Engineers Association
NBMA	Metal Buildings Manufacturers Association <a href="http://www.mbma.com">http://www.mbma.com</a>
MSS	Manufacturers Standardization Society of the Valve and Fittings Industry Inc. <a href="http://www.mss-hq.com">http://www.mss-hq.com</a>
NAAMM	National Association of Architectural Metal Manufacturers <a href="http://www.naamm.org">http://www.naamm.org</a>
NAPHCC	Plumbing-Heating-Cooling Contractors Association <a href="http://www.phccweb.org.org">http://www.phccweb.org.org</a>
NBS	National Bureau of Standards See - NIST
NBBPVI	National Board of Boiler and Pressure Vessel Inspectors <a href="http://www.nationboard.org">http://www.nationboard.org</a>
NEC	National Electric Code See - NFPA National Fire Protection Association
NEMA	National Electrical Manufacturers Association <a href="http://www.nema.org">http://www.nema.org</a>
NFPA	National Fire Protection Association <a href="http://www.nfpa.org">http://www.nfpa.org</a>

- NHLA      National Hardwood Lumber Association  
<http://www.natlhardwood.org>
- NIH National Institute of Health  
<http://www.nih.gov>
- NIST      National Institute of Standards and Technology  
<http://www.nist.gov>
- NLMA      Northeastern Lumber Manufacturers Association, Inc.  
<http://www.nelma.org>
- NPA      National Particleboard Association  
18928 Premiere Court  
Gaithersburg, MD 20879  
(301) 670-0604
- NSF      National Sanitation Foundation  
<http://www.nsf.org>
- NWWDA   Window and Door Manufacturers Association  
<http://www.nwwda.org>
- OSHA      Occupational Safety and Health Administration  
Department of Labor  
<http://www.osha.gov>
- PCA      Portland Cement Association  
<http://www.portcement.org>
- PCI Precast Prestressed Concrete Institute  
<http://www.pci.org>
- PPI The Plastic Pipe Institute  
<http://www.plasticpipe.org>
- PEI Porcelain Enamel Institute, Inc.  
<http://www.porcelainenamel.com>
- PTI Post-Tensioning Institute  
<http://www.post-tensioning.org>
- RFCI      The Resilient Floor Covering Institute  
<http://www.rfci.com>

RIS Redwood Inspection Service

See - CRA

RMA Rubber Manufacturers Association, Inc.

<http://www.rma.org>

SCMA Southern Cypress Manufacturers Association

<http://www.cypressinfo.org>

SDI Steel Door Institute

<http://www.steeldoor.org>

SOI Secretary of the Interior

[http://www.cr.nps.gov/local-law/arch\\_stnds\\_8\\_2.htm](http://www.cr.nps.gov/local-law/arch_stnds_8_2.htm)

IGMA Insulating Glass Manufacturers Alliance

<http://www.igmaonline.org>

SJI Steel Joist Institute

<http://www.steeljoist.org>

SMACNA Sheet Metal and Air-Conditioning Contractors  
National Association, Inc.

<http://www.smacna.org>

SSPC The Society for Protective Coatings

<http://www.sspc.org>

STI Steel Tank Institute

<http://www.steeltank.com>

SWI Steel Window Institute

<http://www.steelwindows.com>

TCA Tile Council of America, Inc.

<http://www.tileusa.com>

TEMA Tubular Exchange Manufacturers Association

<http://www.tema.org>

TPI Truss Plate Institute, Inc.

583 D'Onofrio Drive; Suite 200

Madison, WI 53719

(608) 833-5900

UBC	The Uniform Building Code See ICBO
UL	Underwriters' Laboratories Incorporated <a href="http://www.ul.com">http://www.ul.com</a>
ULC	Underwriters' Laboratories of Canada <a href="http://www.ulc.ca">http://www.ulc.ca</a>
WCLIB	West Coast Lumber Inspection Bureau 6980 SW Varns Road, P.O. Box 23145 Portland, OR 97223 (503) 639-0651
WRCLA	Western Red Cedar Lumber Association P.O. Box 120786 New Brighton, MN 55112 (612) 633-4334
WWPA	Western Wood Products Association <a href="http://www.wwpa.org">http://www.wwpa.org</a>

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**SECTION 01 45 29**  
**TESTING LABORATORY SERVICES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

This section specifies materials testing activities and inspection services required during project construction to be provided by a Testing Laboratory retained by the General Contractor.

**1.2 APPLICABLE PUBLICATIONS:**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.
- B. American Association of State Highway and Transportation Officials (AASHTO):
  - T27-11 ..... Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates
  - T96-02 (R2006) ..... Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
  - T99-10 ..... Standard Method of Test for Moisture-Density Relations of Soils Using a 2.5 Kg (5.5 lb.) Rammer and a 305 mm (12 in.) Drop
  - T104-99 (R2007) ..... Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
  - T180-10 ..... Standard Method of Test for Moisture-Density Relations of Soils using a 4.54 kg (10 lb.) Rammer and a 457 mm (18 in.) Drop
  - T191-02(R2006) ..... Standard Method of Test for Density of Soil In-Place by the Sand-Cone Method
  - T310-13 ..... Standard Method of Test for In-place Density and Moisture Content of Soil and Soil-aggregate by Nuclear Methods (Shallow Depth)
- C. American Concrete Institute (ACI):
  - 506.4R-94 (R2004) ..... Guide for the Evaluation of Shotcrete
- D. American Society for Testing and Materials (ASTM):
  - A325-10 ..... Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
  - A370-12 ..... Standard Test Methods and Definitions for Mechanical Testing of Steel Products
  - A416/A416M-10 ..... Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
  - A490-12 ..... Standard Specification for Heat Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength



C31/C31M-10.....	Standard Practice for Making and Curing Concrete Test Specimens in the Field
C33/C33M-11a.....	Standard Specification for Concrete Aggregates
C39/C39M-12.....	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
C109/C109M-11b.....	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars
C136-06 .....	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
C138/C138M-10b.....	Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
C140-12 .....	Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
C143/C143M-10a.....	Standard Test Method for Slump of Hydraulic Cement Concrete
C172/C172M-10.....	Standard Practice for Sampling Freshly Mixed Concrete
C173/C173M-10b.....	Standard Test Method for Air Content of freshly Mixed Concrete by the Volumetric Method
C330/C330M-09.....	Standard Specification for Lightweight Aggregates for Structural Concrete
C567/C567M-11 .....	Standard Test Method for Density Structural Lightweight Concrete
C780-11 .....	Standard Test Method for Pre-construction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
C1019-11 .....	Standard Test Method for Sampling and Testing Grout
C1064/C1064M-11 .....	Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete
C1077-11c.....	Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
C1314-11a .....	Standard Test Method for Compressive Strength of Masonry Prisms
D422-63(2007) .....	Standard Test Method for Particle-Size Analysis of Soils
D698-07e1 .....	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort
D1140-00(2006) .....	Standard Test Methods for Amount of Material in Soils Finer than No. 200 Sieve

D1143/D1143M-07e1 .....	Standard Test Methods for Deep Foundations Under Static Axial Compressive Load
D1188-07e1 .....	Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples
D1556-07 .....	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
D1557-09 .....	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000ft lbf/ft <sup>3</sup> (2,700 KNm/m <sup>3</sup> ))
D2166-06 .....	Standard Test Method for Unconfined Compressive Strength of Cohesive Soil
D2167-08) .....	Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
D2216-10 .....	Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
D2974-07a .....	Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils
D3666-11 .....	Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
D3740-11 .....	Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as used in Engineering Design and Construction
D6938-10 .....	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
E94-04(2010) .....	Standard Guide for Radiographic Examination
E164-08.....	Standard Practice for Contact Ultrasonic Testing of Weldments
E329-11c.....	Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection
E543-09.....	Standard Specification for Agencies Performing Non-Destructive Testing
E605-93(R2011).....	Standard Test Methods for Thickness and Density of Sprayed Fire Resistive Material (SFRM) Applied to Structural Members
E709-08.....	Standard Guide for Magnetic Particle Examination
E1155-96(R2008).....	Determining FF Floor Flatness and FL Floor Levelness Numbers
E. American Welding Society (AWS):	
D1.D1.1M-10.....	Structural Welding Code-Steel

### **1.3 REQUIREMENTS:**

- A. Accreditation Requirements: Construction materials testing laboratories must be accredited by a laboratory accreditation authority and will be required to submit a copy of the Certificate of Accreditation and Scope of Accreditation. The laboratory's scope of accreditation must include the appropriate ASTM standards (i.e.; E329, C1077, D3666, D3740, A880, E543) listed in the technical sections of the specifications. Laboratories engaged in Hazardous Materials Testing shall meet the requirements of OSHA and EPA. The policy applies to the specific laboratory performing the actual testing, not just the "Corporate Office."
- B. Inspection and Testing: Testing laboratory shall inspect materials and workmanship and perform tests described herein and additional tests requested by Resident Engineer. When it appears materials furnished, or work performed by Contractor fail to meet construction contract requirements, Testing Laboratory shall direct attention of Resident Engineer to such failure.
- C. Written Reports: Testing laboratory shall submit test reports to Resident Engineer, Contractor, unless other arrangements are agreed to in writing by the Resident Engineer. Submit reports of tests that fail to meet construction contract requirements on colored paper.
- D. Verbal Reports: Give verbal notification to Resident Engineer immediately of any irregularity.

### **PART 2 - PRODUCTS (NOT USED)**

### **PART 3 - EXECUTION**

#### **3.1 EARTHWORK:**

- A. General: The Testing Laboratory shall provide qualified personnel, materials, equipment, and transportation as required to perform the services identified/required herein, within the agreed to schedule and/or time frame. The work to be performed shall be as identified herein and shall include but not be limited to the following:
  - 1. Observe fill and subgrades during proof-rolling to evaluate suitability of surface material to receive fill or base course. Provide recommendations to the Resident Engineer regarding suitability or unsuitability of areas where proof-rolling was observed. Where unsuitable results are observed, witness excavation of unsuitable material and recommend to Resident Engineer extent of removal and replacement of unsuitable materials and observe proof-rolling of replaced areas until satisfactory results are obtained.
  - 2. Provide part time observation of fill placement and compaction and field density testing in pavement areas to verify that earthwork compaction obtained is in accordance with contract documents.
- B. Testing Compaction:
  - 1. Determine maximum density and optimum moisture content for each type of fill, backfill and subgrade material used, in compliance with ASTM D698 and/or ASTM D1557.
  - 2. Make field density tests in accordance with the primary testing method following ASTM D6938 or ASTM D2167 shall be utilized on a case by case basis only if there are problems

with the validity of the results from the primary method due to specific site field conditions.

Should the testing laboratory propose these alternative methods, they should provide satisfactory explanation to the Resident Engineer before the tests are conducted.

- a. Pavement Subgrade: One test for each 335 m<sup>2</sup> (400 square yards), but in no case fewer than two tests.
  - d. Footing Subgrade: At least one test for each layer of soil on which footings will be placed. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested subgrade when acceptable to Resident Engineer. In each compacted fill layer below wall footings, perform one field density test for every 30 m (100 feet) of wall. Verify subgrade is level, all loose or disturbed soils have been removed, and correlate actual soil conditions observed with those indicated by test borings.
- C. Not Used
- D. Testing for Footing Bearing Capacity: Evaluate if suitable bearing capacity material is encountered in footing subgrade.

### **3.2 NOT USED**

### **3.3 NOT USED:**

### **3.4 NOT USED**

### **3.5 ASPHALT CONCRETE PAVING:**

- A. Aggregate Base Course:
  - 1. Determine maximum density and optimum moisture content for aggregate base material in accordance with AASHTO T180, Method D
  - 2. Make a minimum of three field density tests on each day's final compaction on each aggregate course in accordance with AASHTO T191.

### **3.6 SITE WORK CONCRETE:**

Test site work concrete including materials for concrete as required in Article CONCRETE of this section.

### **3.7 NOT USED**

### **3.8 CONCRETE:**

- A. Not Used
- B. Field Inspection and Materials Testing:
  - 1. Provide a technician at site of placement at all times to perform concrete sampling and testing.
  - 2. Review the delivery tickets of the ready-mix concrete trucks arriving on-site. Notify the Contractor if the concrete cannot be placed within the specified time limits or if the type of concrete delivered is incorrect. Reject any loads that do not comply with the Specification

- requirements. Rejected loads are to be removed from the site at the Contractor's expense. Any rejected concrete that is placed will be subject to removal.
3. Take concrete samples at point of placement in accordance with ASTM C172. Mold and cure compression test cylinders in accordance with ASTM C31. Make at least three cylinders for each 50 cubic yards or less of each concrete type, and at least three cylinders for any one day's pour for each concrete type. Label each cylinder with an identification number. Resident Engineer may require additional cylinders to be molded and cured under job conditions.
  4. Perform slump tests in accordance with ASTM C143. Test the first truck each day, and every time test cylinders are made. Test pumped concrete at the hopper and at the discharge end of the hose at the beginning of each day's pumping operations to determine change in slump.
  5. Determine the air content of concrete per ASTM C173. For concrete required to be air-entrained, test the first truck and every 20 m<sup>3</sup> (25 cubic yards) thereafter each day. For concrete not required to be air-entrained, test every 80 m<sup>3</sup> (100 cubic yards) at random. For pumped concrete, initially test concrete at both the hopper and the discharge end of the hose to determine change in air content.
  6. If slump or air content fall outside specified limits, make another test immediately from another portion of same batch.
  7. Perform unit weight tests in compliance with ASTM C138 for normal weight concrete and ASTM C567 for lightweight concrete. Test the first truck and each time cylinders are made.
  8. Notify laboratory technician at batch plant of mix irregularities and request materials and proportioning check.
  9. Verify that specified mixing has been accomplished.
  10. Environmental Conditions: Determine the temperature per ASTM C1064 for each truckload of concrete during hot weather and cold weather concreting operations:
    - a. When ambient air temperature falls below 4.4 degrees C (40 degrees F), record maximum and minimum air temperatures in each 24 hour period; record air temperature inside protective enclosure; record minimum temperature of surface of hardened concrete.
    - b. When ambient air temperature rises above 29.4 degrees C (85 degrees F), record maximum and minimum air temperature in each 24 hour period; record minimum relative humidity; record maximum wind velocity; record maximum temperature of surface of hardened concrete.
  11. Inspect the reinforcing steel placement, including bar size, bar spacing, top and bottom concrete cover, proper tie into the chairs, and grade of steel prior to concrete placement. Submit detailed report of observations.
  12. Observe conveying, placement, and consolidation of concrete for conformance to specifications.

13. Observe condition of formed surfaces upon removal of formwork prior to repair of surface defects and observe repair of surface defects.
  14. Observe curing procedures for conformance with specifications, record dates of concrete placement, start of preliminary curing, start of final curing, end of curing period.
  15. Observe preparations for placement of concrete:
    - a. Inspect handling, conveying, and placing equipment, inspect vibrating and compaction equipment.
    - b. Inspect preparation of construction, expansion, and isolation joints.
  16. Observe preparations for protection from hot weather, cold weather, sun, and rain, and preparations for curing.
  17. Observe concrete mixing:
    - a. Monitor and record amount of water added at project site.
    - b. Observe minimum and maximum mixing times.
- C. Laboratory Tests of Field Samples:
1. Test compression test cylinders for strength in accordance with ASTM C39. For each test series, test one cylinder at 7 days and one cylinder at 28 days. Use remaining cylinder as a spare tested as directed by Resident Engineer. Compile laboratory test reports as follows: Compressive strength test shall be result of one cylinder, except when one cylinder shows evidence of improper sampling, molding or testing, in which case it shall be discarded and strength of spare cylinder shall be used.
  2. Make weight tests of hardened lightweight structural concrete in accordance with ASTM C567.
  3. Furnish certified compression test reports (duplicate) to Resident Engineer. In test report, indicate the following information:
    - a. Cylinder identification number and date cast.
    - b. Specific location at which test samples were taken.
    - c. Type of concrete, slump, and percent air.
    - d. Compressive strength of concrete in MPa (psi).
    - e. Weight of lightweight structural concrete in kg/m<sup>3</sup> (pounds per cubic feet).
    - f. Weather conditions during placing.
    - g. Temperature of concrete in each test cylinder when test cylinder was molded.
    - h. Maximum and minimum ambient temperature during placing.
    - i. Ambient temperature when concrete sample in test cylinder was taken.
    - j. Date delivered to laboratory and date tested.

--- E N D ---

**SECTION 01 57 19**  
**TEMPORARY ENVIRONMENTAL CONTROLS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the control of environmental pollution and damage that the Contractor must consider for air, water, and land resources. It includes management of visual aesthetics, noise, solid waste, radiant energy, and radioactive materials, as well as other pollutants and resources encountered or generated by the Contractor. The Contractor is obligated to consider specified control measures with the costs included within the various contract items of work.
- B. Environmental pollution and damage is defined as the presence of chemical, physical, or biological elements or agents which:
  - 1. Adversely effect human health or welfare,
  - 2. Unfavorably alter ecological balances of importance to human life,
  - 3. Effect other species of importance to humankind, or;
  - 4. Degrade the utility of the environment for aesthetic, cultural, and historical purposes.
- C. Definitions of Pollutants:
  - 1. Chemical Waste: Petroleum products, bituminous materials, salts, acids, alkalis, herbicides, pesticides, organic chemicals, and inorganic wastes.
  - 2. Debris: Combustible and noncombustible wastes, such as leaves, tree trimmings, ashes, and waste materials resulting from construction or maintenance and repair work.
  - 3. Sediment: Soil and other debris that has been eroded and transported by runoff water.
  - 4. Solid Waste: Rubbish, debris, garbage, and other discarded solid materials resulting from industrial, commercial, and agricultural operations and from community activities.
  - 5. Surface Discharge: The term "Surface Discharge" implies that the water is discharged with possible sheeting action and subsequent soil erosion may occur. Waters that are surface discharged may terminate in drainage ditches, storm sewers, creeks, and/or "water of the United States" and would require a permit to discharge water from the governing agency.
  - 6. Rubbish: Combustible and noncombustible wastes such as paper, boxes, glass and crockery, metal and lumber scrap, tin cans, and bones.
  - 7. Sanitary Wastes:
    - a. Sewage: Domestic sanitary sewage and human and animal waste.
    - b. Garbage: Refuse and scraps resulting from preparation, cooking, dispensing, and consumption of food.

**1.2 QUALITY CONTROL**

- A. Establish and maintain quality control for the environmental protection of all items set forth herein.
- B. Record on daily reports any problems in complying with laws, regulations, and ordinances. Note any corrective action taken.

### 1.3 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. U.S. National Archives and Records Administration (NARA):  
33 CFR 328.....Definitions

### 1.4 SUBMITTALS

- A. In accordance with Section, 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
  - 1. Environmental Protection Plan: After the contract is awarded and prior to the commencement of the work, the Contractor shall meet with the Resident Engineer to discuss the proposed Environmental Protection Plan and to develop mutual understanding relative to details of environmental protection. Not more than 20 days after the meeting, the Contractor shall prepare and submit to the VA for approval, a written and/or graphic Environmental Protection Plan including, but not limited to, the following:
    - a. Name(s) of person(s) within the Contractor's organization who is (are) responsible for ensuring adherence to the Environmental Protection Plan.
    - b. Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from the site.
    - c. Name(s) and qualifications of person(s) responsible for training the Contractor's environmental protection personnel.
    - d. Description of the Contractor's environmental protection personnel training program.
    - e. A list of Federal, State, and local laws, regulations, and permits concerning environmental protection, pollution control, noise control and abatement that are applicable to the Contractor's proposed operations and the requirements imposed by those laws, regulations, and permits.
    - f. Methods for protection of features to be preserved within authorized work areas including trees, shrubs, vines, grasses, ground cover, landscape features, air and water quality, fish and wildlife, soil, historical, and archeological and cultural resources.
    - g. Procedures to provide the environmental protection that comply with the applicable laws and regulations. Describe the procedures to correct pollution of the environment due to accident, natural causes, or failure to follow the procedures as described in the Environmental Protection Plan.
    - h. Permits, licenses, and the location of the solid waste disposal area.
    - i. Drawings showing locations of any proposed temporary excavations or embankments for haul roads, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials. Include as part of an Erosion Control Plan approved by the District Office of the U.S. Soil Conservation Service and the Department of Veterans Affairs.



- j. Environmental Monitoring Plans for the job site including land, water, air, and noise.
  - k. Work Area Plan showing the proposed activity in each portion of the area and identifying the areas of limited use or nonuse. Plan should include measures for marking the limits of use areas. This plan may be incorporated within the Erosion Control Plan.
- B. Approval of the Contractor's Environmental Protection Plan will not relieve the Contractor of responsibility for adequate and continued control of pollutants and other environmental protection measures.

## **1.5 PROTECTION OF ENVIRONMENTAL RESOURCES**

- A. Protect environmental resources within the project boundaries and those affected outside the limits of permanent work during the entire period of this contract. Confine activities to areas defined by the specifications and drawings.
- B. Protection of Land Resources: Prior to construction, identify all land resources to be preserved within the work area. Do not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, top soil, and land forms without permission from the Resident Engineer. Do not fasten or attach ropes, cables, or guys to trees for anchorage unless specifically authorized, or where special emergency use is permitted.
- 1. Work Area Limits: Prior to any construction, mark the areas that require work to be performed under this contract. Mark or fence isolated areas within the general work area that are to be saved and protected. Protect monuments, works of art, and markers before construction operations begin. Convey to all personnel the purpose of marking and protecting all necessary objects.
  - 2. Protection of Landscape: Protect trees, shrubs, vines, grasses, land forms, and other landscape features shown on the drawings to be preserved by marking, fencing, or using any other approved techniques.
    - a. Box and protect from damage existing trees and shrubs to remain on the construction site.
    - b. Immediately repair all damage to existing trees and shrubs by trimming, cleaning, and painting with antiseptic tree paint.
    - c. Do not store building materials or perform construction activities closer to existing trees or shrubs than the farthest extension of their limbs.
  - 3. Reduction of Exposure of Unprotected Erodible Soils: Plan and conduct earthwork to minimize the duration of exposure of unprotected soils. Clear areas in reasonably sized increments only as needed to use. Form earthwork to final grade as shown. Immediately protect side slopes and back slopes upon completion of rough grading.
  - 4. Temporary Protection of Disturbed Areas: Construct diversion ditches, benches, and berms to retard and divert runoff from the construction site to protected drainage areas approved under paragraph 208 of the Clean Water Act.

- a. Not Used
  - b. Reuse or conserve the collected topsoil sediment as directed by the Resident Engineer.  
Topsoil use and requirements are specified in Section 31 20 00, EARTH MOVING.
  - c. Institute effluent quality monitoring programs as required by Federal, State, and local environmental agencies.
5. Erosion and Sedimentation Control Devices: The erosion and sediment controls selected and maintained by the Contractor shall be such that water quality standards are not violated as a result of the Contractor's activities. Construct or install all temporary and permanent erosion and sedimentation control features on the Environmental Protection Plan. Maintain temporary erosion and sediment control measures such as berms, dikes, drains, sedimentation basins, grassing, and mulching, until permanent drainage and erosion control facilities are completed and operative.
6. Manage borrow areas on Government property to minimize erosion and to prevent sediment from entering nearby water courses or lakes.
7. Manage and control spoil areas on Government property to limit spoil to areas on the Environmental Protection Plan and prevent erosion of soil or sediment from entering nearby water courses or lakes.
8. Protect adjacent areas from despoilment by temporary excavations and embankments.
9. Handle and dispose of solid wastes in such a manner that will prevent contamination of the environment. Place solid wastes (excluding clearing debris) in containers that are emptied on a regular schedule. Transport all solid waste off Government property and dispose of waste in compliance with Federal, State, and local requirements.
10. Store chemical waste away from the work areas in corrosion resistant containers and dispose of waste in accordance with Federal, State, and local regulations.
11. Handle discarded materials other than those included in the solid waste category as directed by the Resident Engineer.
- C. Protection of Water Resources: Keep construction activities under surveillance, management, and control to avoid pollution of surface and ground waters and sewer systems. Implement management techniques to control water pollution by the listed construction activities that are included in this contract.
  1. Washing and Curing Water: Do not allow wastewater directly derived from construction activities to enter water areas. Collect and place wastewater in retention ponds allowing the suspended material to settle, the pollutants to separate, or the water to evaporate.
  2. Control movement of materials and equipment at stream crossings during construction to prevent violation of water pollution control standards of the Federal, State, or local government.
  3. Monitor water areas affected by construction.

- D. Not Used
- E. Protection of Air Resources: Keep construction activities under surveillance, management, and control to minimize pollution of air resources. Burning is not permitted on the job site. Keep activities, equipment, processes, and work operated or performed, in strict accordance with the State of Ohio and Federal emission and performance laws and standards. Maintain ambient air quality standards set by the Environmental Protection Agency, for those construction operations and activities specified.
1. Particulates: Control dust particles, aerosols, and gaseous by-products from all construction activities, processing, and preparation of materials (such as from asphaltic batch plants) at all times, including weekends, holidays, and hours when work is not in progress.
  2. Particulates Control: Maintain all excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and all other work areas within or outside the project boundaries free from particulates which would cause a hazard or a nuisance. Sprinklering, chemical treatment of an approved type, light bituminous treatment, baghouse, scrubbers, electrostatic precipitators, or other methods are permitted to control particulates in the work area.
  3. Hydrocarbons and Carbon Monoxide: Control monoxide emissions from equipment to Federal and State allowable limits.
  4. Odors: Control odors of construction activities and prevent obnoxious odors from occurring.
- F. Reduction of Noise: Minimize noise using every action possible. Perform noise-producing work in less sensitive hours of the day or week as directed by the Resident Engineer. Maintain noise-produced work at or below the decibel levels and within the time periods specified.
1. Perform construction activities involving repetitive, high-level impact noise only between 4:00 p.m. and 10:00 p.m. unless otherwise permitted by local ordinance or the Resident Engineer. Repetitive impact noise on the property shall not exceed the following dB limitations:

Time Duration of Impact Noise	Sound Level in dB
More than 12 minutes in any hour	70
Less than 30 seconds of any hour	85
Less than three minutes of any hour	80
Less than 12 minutes of any hour	75

2. Provide sound-deadening devices on equipment and take noise abatement measures that are necessary to comply with the requirements of this contract, consisting of, but not limited to, the following:
  - a. Maintain maximum permissible construction equipment noise levels at 15 m (50 feet) (dBA):

EARTHMOVING

MATERIALS HANDLING

FRONT LOADERS	75	CONCRETE MIXERS	75
BACKHOES	75	CONCRETE PUMPS	75
DOZERS	75	CRANES	75
TRACTORS	75	DERRICKS IMPACT	75
SCAPERS	80	PILE DRIVERS	95
GRADERS	75	JACK HAMMERS	75
TRUCKS	75	ROCK DRILLS	80
PAVERS, STATIONARY	80	PNEUMATIC TOOLS	80
PUMPS	75	BLASTING	N/A
GENERATORS	75	SAWS	75
COMPRESSORS	75	VIBRATORS	75

- b. Use shields or other physical barriers to restrict noise transmission.
  - c. Provide soundproof housings or enclosures for noise-producing machinery.
  - d. Use efficient silencers on equipment air intakes.
  - e. Use efficient intake and exhaust mufflers on internal combustion engines that are maintained so equipment performs below noise levels specified.
  - f. Line hoppers and storage bins with sound deadening material.
  - g. Conduct truck loading, unloading, and hauling operations so that noise is kept to a minimum.
3. Measure sound level for noise exposure due to the construction at least once every five successive working days while work is being performed above 75 dB(A) noise level. Measure noise exposure at the property line or 15 m (50 feet) from the noise source, whichever is greater. Measure the sound levels on the A weighing network of a General Purpose sound level meter at slow response. To minimize the effect of reflective sound waves at buildings, take measurements at 900 to 1800 mm (three to six feet) in front of any building face. Submit the recorded information to the Resident Engineer noting any problems and the alternatives for mitigating actions.
- G. Restoration of Damaged Property: If any direct or indirect damage is done to public or private property resulting from any act, omission, neglect, or misconduct, the Contractor shall restore the damaged property to a condition equal to that existing before the damage at no additional cost to the Government. Repair, rebuild, or restore property as directed or make good such damage in an acceptable manner.
  - H. Final Clean-up: On completion of project and after removal of all debris, rubbish, and temporary construction, Contractor shall leave the construction area in a clean condition satisfactory to the Resident Engineer. Cleaning shall include off the station disposal of all items and materials not

required to be salvaged, as well as all debris and rubbish resulting from demolition and new work operations.

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**SECTION 01 74 19**  
**CONSTRUCTION WASTE MANAGEMENT**

**PART 1 – GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the requirements for the management of non-hazardous building construction and demolition waste.
- B. Waste disposal in landfills shall be minimized to the greatest extent possible. Of the inevitable waste that is generated, as much of the waste material as economically feasible shall be salvaged, recycled or reused.
- C. Contractor shall use all reasonable means to divert construction and demolition waste from landfills and incinerators, and facilitate their salvage and recycle not limited to the following:
  - 1. Waste Management Plan development and implementation.
  - 2. Techniques to minimize waste generation.
  - 3. Sorting and separating of waste materials.
  - 4. Salvage of existing materials and items for reuse or resale.
  - 5. Recycling of materials that cannot be reused or sold.
- D. At a minimum the following waste categories shall be diverted from landfills:
  - 1. Soil.
  - 2. Inerts (eg, concrete, masonry and asphalt).
  - 3. Clean dimensional wood and palette wood.
  - 4. Green waste (biodegradable landscaping materials).
  - 5. Engineered wood products (plywood, particle board and I-joists, etc).
  - 6. Metal products (eg, steel, wire, beverage containers, copper, etc).
  - 7. Cardboard, paper and packaging.
  - 8. Bitumen roofing materials.
  - 9. Plastics (eg, ABS, PVC).
  - 10. Carpet and/or pad.
  - 11. Gypsum board.
  - 12. Insulation.
  - 13. Paint.
  - 14. Fluorescent lamps.

**1.2 RELATED WORK**

- A. Section 01 00 00, GENERAL REQUIREMENTS.

**1.3 QUALITY ASSURANCE**

- A. Contractor shall practice efficient waste management when sizing, cutting and installing building products. Processes shall be employed to ensure the generation of as little waste as possible. Construction /Demolition waste includes products of the following:

1. Excess or unusable construction materials.
  2. Packaging used for construction products.
  3. Poor planning and/or layout.
  4. Construction error.
  5. Over ordering.
  6. Weather damage.
  7. Contamination.
  8. Mishandling.
  9. Breakage.
- B. Establish and maintain the management of non-hazardous building construction and demolition waste set forth herein. Conduct a site assessment to estimate the types of materials that will be generated by demolition and construction.
- C. Contractor shall develop and implement procedures to recycle construction and demolition waste to a minimum of 50 percent.
- D. Contractor shall be responsible for implementation of any special programs involving rebates or similar incentives related to recycling. Any revenues or savings obtained from salvage or recycling shall accrue to the contractor.
- E. Contractor shall provide all demolition, removal and legal disposal of materials. Contractor shall ensure that facilities used for recycling, reuse and disposal shall be permitted for the intended use to the extent required by local, state, federal regulations. The Whole Building Design Guide website <http://www.wbdg.org/tools/cwm.php> provides a Construction Waste Management Database that contains information on companies that haul, collect, and process recyclable debris from construction projects.
- F. Contractor shall assign a specific area to facilitate separation of materials for reuse, salvage, recycling, and return. Such areas are to be kept neat and clean and clearly marked in order to avoid contamination or mixing of materials.
- G. Contractor shall provide on-site instructions and supervision of separation, handling, salvaging, recycling, reuse and return methods to be used by all parties during waste generating stages.
- H. Record on daily reports any problems in complying with laws, regulations and ordinances with corrective action taken.

#### **1.4 TERMINOLOGY**

- A. Class III Landfill: A landfill that accepts non-hazardous resources such as household, commercial and industrial waste resulting from construction, remodeling, repair and demolition operations.
- B. Clean: Untreated and unpainted; uncontaminated with adhesives, oils, solvents, mastics and like products.
- C. Construction and Demolition Waste: Includes all non-hazardous resources resulting from construction, remodeling, alterations, repair and demolition operations.

- D. Dismantle: The process of parting out a building in such a way as to preserve the usefulness of its materials and components.
- E. Disposal: Acceptance of solid wastes at a legally operating facility for the purpose of land filling (includes Class III landfills and inert fills).
- F. Inert Backfill Site: A location, other than inert fill or other disposal facility, to which inert materials are taken for the purpose of filling an excavation, shoring or other soil engineering operation.
- G. Inert Fill: A facility that can legally accept inert waste, such as asphalt and concrete exclusively for the purpose of disposal.
- H. Inert Solids/Inert Waste: Non-liquid solid resources including, but not limited to, soil and concrete that does not contain hazardous waste or soluble pollutants at concentrations in excess of water-quality objectives established by a regional water board, and does not contain significant quantities of decomposable solid resources.
- I. Mixed Debris: Loads that include commingled recyclable and non-recyclable materials generated at the construction site.
- J. Mixed Debris Recycling Facility: A solid resource processing facility that accepts loads of mixed construction and demolition debris for the purpose of recovering re-usable and recyclable materials and disposing non-recyclable materials.
- K. Permitted Waste Hauler: A company that holds a valid permit to collect and transport solid wastes from individuals or businesses for the purpose of recycling or disposal.
- L. Recycling: The process of sorting, cleansing, treating, and reconstituting materials for the purpose of using the altered form in the manufacture of a new product. Recycling does not include burning, incinerating or thermally destroying solid waste.
  - 1. On-site Recycling – Materials that are sorted and processed on site for use in an altered state in the work, i.e. concrete crushed for use as a sub-base in paving.
  - 2. Off-site Recycling – Materials hauled to a location and used in an altered form in the manufacture of new products.
- M. Recycling Facility: An operation that can legally accept materials for the purpose of processing the materials into an altered form for the manufacture of new products. Depending on the types of materials accepted and operating procedures, a recycling facility may or may not be required to have a solid waste facilities permit or be regulated by the local enforcement agency.
- N. Reuse: Materials that are recovered for use in the same form, on-site or off-site.
- O. Return: To give back reusable items or unused products to vendors for credit.
- P. Salvage: To remove waste materials from the site for resale or re-use by a third party.
- Q. Source-Separated Materials: Materials that are sorted by type at the site for the purpose of reuse and recycling.
- R. Solid Waste: Materials that have been designated as non-recyclable and are discarded for the purposes of disposal.



- S. Transfer Station: A facility that can legally accept solid waste for the purpose of temporarily storing the materials for re-loading onto other trucks and transporting them to a landfill for disposal, or recovering some materials for re-use or recycling.

## **1.5 SUBMITTALS**

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES, furnish the following:
- B. Prepare and submit to the VA a written demolition debris management plan. The plan shall include, but not be limited to, the following information:
  - 1. Procedures to be used for debris management.
  - 2. Techniques to be used to minimize waste generation.
  - 3. Analysis of the estimated job site waste to be generated:
    - a. List of each material and quantity to be salvaged, reused, recycled.
    - b. List of each material and quantity proposed to be taken to a landfill.
  - 4. Detailed description of the Means/Methods to be used for material handling.
    - a. On site: Material separation, storage, protection where applicable.
    - b. Off site: Transportation means and destination. Include list of materials.
      - 1) Description of materials to be site-separated and self-hauled to designated facilities.
      - 2) Description of mixed materials to be collected by designated waste haulers and removed from the site.
    - c. The names and locations of mixed debris reuse and recycling facilities or sites.
    - d. The names and locations of trash disposal landfill facilities or sites.
    - e. Documentation that the facilities or sites are approved to receive the materials.
- C. Designated Manager responsible for instructing personnel, supervising, documenting and administer over meetings relevant to the Waste Management Plan.
- D. Monthly summary of construction and demolition debris diversion and disposal, quantifying all materials generated at the work site and disposed of or diverted from disposal through recycling.

## **1.6 APPLICABLE PUBLICATIONS**

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced by the basic designation only. In the event that criteria requirements conflict, the most stringent requirements shall be met.
- B. U.S. Green Building Council (USGBC):  
LEED Green Building Rating System for New Construction

## **1.7 RECORDS**

Maintain records to document the quantity of waste generated; the quantity of waste diverted through sale, reuse, or recycling; and the quantity of waste disposed by landfill or incineration. Records shall be kept in accordance with the LEED Reference Guide and LEED Template.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. List of each material and quantity to be salvaged, recycled, reused.
- B. List of each material and quantity proposed to be taken to a landfill.
- C. Material tracking data: Receiving parties, dates removed, transportation costs, weight tickets, tipping fees, manifests, invoices, net total costs or savings.

## **PART 3 - EXECUTION**

### **3.1 COLLECTION**

- A. Provide all necessary containers, bins and storage areas to facilitate effective waste management.
- B. Clearly identify containers, bins and storage areas so that recyclable materials are separated from trash and can be transported to respective recycling facility for processing.
- C. Hazardous wastes shall be separated, stored, disposed of according to local, state, federal regulations.

### **3.2 DISPOSAL**

- A. Contractor shall be responsible for transporting and disposing of materials that cannot be delivered to a source-separated or mixed materials recycling facility to a transfer station or disposal facility that can accept the materials in accordance with state and federal regulations.
- B. Construction or demolition materials with no practical reuse or that cannot be salvaged or recycled shall be disposed of at a landfill or incinerator.

### **3.3 REPORT**

- A. With each application for progress payment, submit a summary of construction and demolition debris diversion and disposal including beginning and ending dates of period covered.
- B. Quantify all materials diverted from landfill disposal through salvage or recycling during the period with the receiving parties, dates removed, transportation costs, weight tickets, manifests, invoices. Include the net total costs or savings for each salvaged or recycled material.
- C. Quantify all materials disposed of during the period with the receiving parties, dates removed, transportation costs, weight tickets, tipping fees, manifests, invoices. Include the net total costs for each disposal.

--- E N D ---

# Geotechnical Engineering Report

**Chillicothe VAMC-SPD Addition to Building 31**

**Chillicothe, Ohio**

April 26, 2013

Terracon Project Number: N1135044

**Prepared for:**

John Poe Architects

Dayton, Ohio

**Prepared by:**

Terracon Consultants, Inc.

Cincinnati, Ohio

Offices Nationwide  
Employee-Owned

Established in 1965  
[terracon.com](http://terracon.com)

**Terracon**

Geotechnical   ■   Environmental   ■   Construction Materials   ■   Facilities

April 26, 2013



John Poe Architects, LLC  
116 East Third Street  
Dayton, Ohio 45402

Attn: Mr. Jason Ross, AIA  
Architect  
P: (937) 461-3290  
F: (937) 461-0260  
E: jross@johnpoe.com

Re: Geotechnical Engineering Report  
Chillicothe VAMC – SPD Addition to Building 31  
17273 SR 104  
Chillicothe, Ohio  
Terracon Project Number: N1135044

Dear Mr. Ross:

Terracon Consultants, Inc (Terracon) has completed the geotechnical engineering services for the above referenced project. This study was performed in general accordance with our proposal number PN1120335 dated April 27, 2012. Preliminary foundation recommendations were provided on April 9, 2013. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations and floor slabs, and basement wall design parameters for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,  
**Terracon Consultants**

A blue ink signature of Jeffrey D. Dunlap.

Jeffrey D. Dunlap, P.E.  
Senior Geotechnical Engineer

A blue ink signature of Ronald J. Ebelhar.

Ronald J. Ebelhar, P.E.  
Senior Principal

cc: Mr. Frank Ellert, P.E. – THP Limited, LLC



Terracon Consultants Inc. 611 Lunken Park Drive Cincinnati, Ohio 45226  
P [513] 321 5816 F [513] 321 0294 [www.terracon.com](http://www.terracon.com)

Geotechnical

Environmental

Construction Materials

Facilities

## **APPENDIX A – FIELD EXPLORATION**

Exhibit A-1	Site Location Map
Exhibit A-2	Test Boring Location Plan
Exhibit A-3	Summary of Geotechnical Data
Exhibit A-4	Field Exploration Description
Test Boring Logs	SPD-1 to SPD-7, L-1, SB-1 and EB-2 to EB4

## **APPENDIX B – LABORATORY TESTING**

Exhibit B-1	Laboratory Testing Program Description
Exhibits B-2 to B-15	Laboratory Test Plots

## **APPENDIX C – SUPPORTING DOCUMENTS**

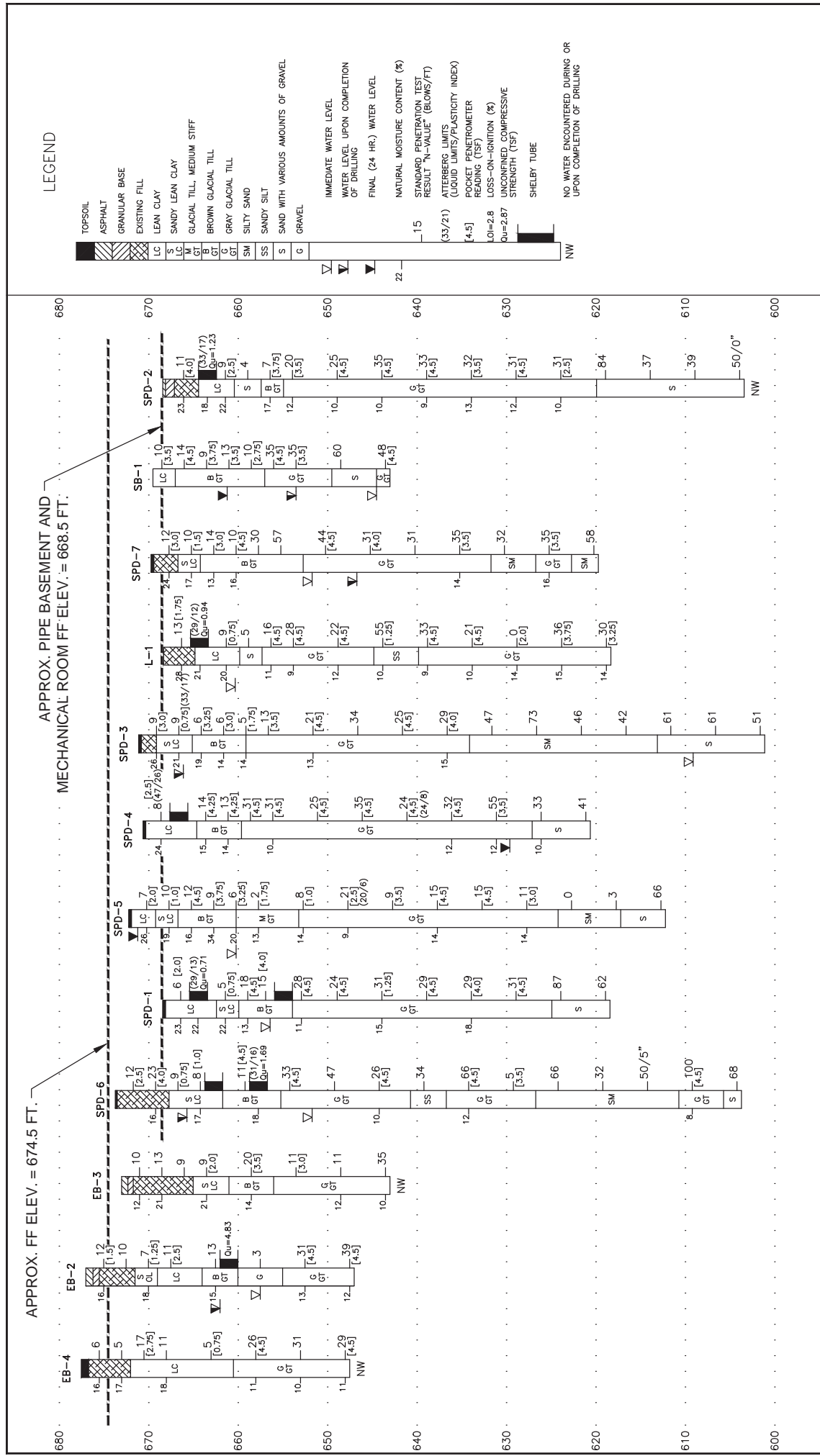
Exhibit C-1	General Notes
Exhibit C-2	Unified Soil Classification System

**APPENDIX A**  
**FIELD EXPLORATION**









## **Field Exploration Description**

The boring locations were laid out on the site by Terracon personnel by referencing existing site features. Ground surface elevations at boring locations were obtained using a Leica Viva Net rover survey-grade GPS. The locations and elevations of the borings should be considered accurate only to the degree implied by the means and methods used to define them. Some of the test boring locations were then relocated a few feet from the original locations based upon the results of the underground utility location performed by a private utility location service, which was one of our subcontractors.

The borings were drilled with track-mounted rotary drill rig using continuous flight hollow-stem augers to advance the boreholes. Samples of the soil encountered in the borings were obtained using the split-barrel sampling procedures. In the split-barrel sampling procedure, the number of blows required to advance a standard 2-inch O.D. split-barrel sampler the last 12 inches of the typical total 18-inch penetration by means of a rope and cathead manual safety hammer with a free fall of 30 inches, is the standard penetration resistance value (SPT-N). This value is used to estimate the in-situ relative density of cohesionless soils and consistency of cohesive soils. Several relatively undisturbed soil samples were obtained by pushing thin-wall Shelby tubes in cohesive soil stratum.

An automatic SPT hammer was used to advance the split-barrel sampler in the borings performed on this site. A greater efficiency is typically achieved with the automatic hammer compared to the conventional safety hammer operated with a cathead and rope. Published correlations between the SPT values and soil properties are based on the lower efficiency cathead and rope method. This higher efficiency affects the standard penetration resistance blow count (N) value by increasing the penetration per hammer blow over what would be obtained using the cathead and rope method. The effect of the automatic hammer's efficiency has been considered in the interpretation and analysis of the subsurface information for this report.

The samples were tagged for identification, sealed to reduce moisture loss, and taken to our laboratory for further examination, testing, and classification. Information provided on the boring logs attached to this report includes soil descriptions, consistency evaluations, boring depths, sampling intervals, and groundwater conditions. The borings were backfilled with auger cuttings prior to the drill crew leaving the site. Where pavement was encountered at the ground surface, the borings were capped with Sakrete and leveled with the surrounding grades. In addition, a Sakrete plug was placed in the top of each borehole in lawn areas to limit the potential for subsidence at the top of the boreholes, in an effort to avoid creating trip hazards.

A field log of each boring was prepared by the drill crew. These logs included visual classifications of the materials encountered during drilling as well as the driller's interpretation of the subsurface conditions between samples. Final boring logs included with this report represent the engineer's review of obtained soil samples, driller's field logs and include modifications based on laboratory tests of the samples.

# BORING LOG NO. SPD-1

Page 1 of 2

PROJECT: VAMC SPD Addition

CLIENT: John Poe Architects

SITE: 17273 State Route 104  
Chillicothe, Ohio

ELEVATION REFERENCE:  
Survey Grade GPS Unit

GRAPHIC LOG	LOCATION See Exhibit A-2	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	Loss on Ignition	LABORATORY TORVANE/HP (psf)	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS
									TEST TYPE	COMPRESSIVE STRENGTH (psf)	STRAIN (%)			
	Surface Elev.: 668.4 (Ft.)													LL-PL-PI
	DEPTH ELEVATION (Ft.)													
	0.3 <b>TOPSOIL (4")</b> 668													
	<b>LEAN CLAY (CL)</b> , brown, medium stiff to stiff, trace root matter				100	3-3-3 N=6		2.0 (HP)				23		
					100					1424	4.8	22	103	29-16-13
	6.0 662.5													
	<b>SANDY LEAN CLAY (CL)</b> , trace gravel, brown, medium stiff				100	1-2-3 N=5		0.75 (HP)				22		
	8.5 660													
	<b>LEAN CLAY (CL)</b> , with gravel, brown, hard				100	4-8-10 N=18		4.5 (HP)				13		
	11.0 657.5													
	<b>SANDY LEAN CLAY (CL)</b> , with gravel, with sand seams, brown, hard				100	5-9-6 N=15		4.0 (HP)						
	14.5 654				40			4.5 (HP)						
	<b>LEAN CLAY (CL)</b> , with sand, with gravel, gray, hard, (GLACIAL TILL)				100	7-10-18 N=28		4.5 (HP)				11		
	23.5 645													
	<b>SANDY LEAN CLAY (CL)</b> , with gravel, gray, stiff, (GLACIAL TILL)				100	11-15-16 N=31		4.5 (HP)				15		
	28.5 640													
	<b>LEAN CLAY (CL)</b> , with sand, with gravel, gray, hard, (GLACIAL TILL)				100	11-15-14 N=29		4.0 (HP)						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:  
3.25" Hollow Stem Auger

See Exhibit A-4 for description of field procedures

Notes:

Abandonment Method:  
Borings backfilled with soil cuttings upon completion.

See Appendix B for description of laboratory procedures and additional data (if any).  
See Appendix C for explanation of symbols and abbreviations.

## WATER LEVEL OBSERVATIONS

Water observed at 12 ft. during drilling

Water observed at 3 ft. after 24 hrs

**Terracon**  
611 Lunken Park Drive  
Cincinnati, Ohio

Boring Started: 3/26/2013

Drill Rig: Track

Project No.: N1135044

Boring Completed: 3/26/2013

Driller: Moore

Exhibit: A-5

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL N1135044 TEST BORING LOGS.GPJ TERRACON2012.GDT 4/26/13

# BORING LOG NO. SPD-1




Page 2 of 2

PROJECT: VAMC SPD Addition

CLIENT: John Poe Architects

SITE: 17273 State Route 104  
Chillicothe, Ohio

ELEVATION REFERENCE:  
Survey Grade GPS Unit

GRAPHIC LOG	LOCATION See Exhibit A-2	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	Loss on Ignition	LABORATORY TORVANE/HP (psf)	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS
									TEST TYPE	COMPRESSIVE STRENGTH (psf)	STRAIN (%)			
	Surface Elev.: 668.4 (Ft.) DEPTH ELEVATION (Ft.)													LL-PL-PI
	<b>LEAN CLAY (CL)</b> , with sand, with gravel, gray, hard, (GLACIAL TILL) (continued)	35		X	100	11-12-17 N=29		4.5 (HP)				18		
		40		X	100	12-13-18 N=31								
	<b>SAND AND GRAVEL (SP)</b> , brown, very dense	45		X	100	17-28-59 N=87								
	<b>POORLY GRADED SAND WITH SILT (SP-SM)</b> , trace gravel, brown, very dense	50		X	100	32-31-31 N=62								
	<b>Boring Terminated at 50 Feet</b>													

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:  
3.25" Hollow Stem Auger


See Exhibit A-4 for description of field procedures

Notes:

Abandonment Method:  
Borings backfilled with soil cuttings upon completion.

See Appendix B for description of laboratory procedures and additional data (if any).  
See Appendix C for explanation of symbols and abbreviations.

## WATER LEVEL OBSERVATIONS

 Water observed at 12 ft. during drilling

 Water observed at 3 ft. after 24 hrs

**Terracon**  
611 Lunken Park Drive  
Cincinnati, Ohio

Boring Started: 3/26/2013

Boring Completed: 3/26/2013

Drill Rig: Track

Driller: Moore

Project No.: N1135044

Exhibit: A-6

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL N1135044 TEST BORING LOGS.GPJ TERRACON2012.GDT 4/26/13

# BORING LOG NO. SPD-2

Page 1 of 2

PROJECT: VAMC SPD Addition

CLIENT: John Poe Architects

SITE: 17273 State Route 104  
Chillicothe, Ohio

ELEVATION REFERENCE:  
Survey Grade GPS Unit

GRAPHIC LOG	LOCATION See Exhibit A-2	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	Loss on Ignition	LABORATORY TORVANE/HP (psf)	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS
									TEST TYPE	COMPRESSIVE STRENGTH (psf)	STRAIN (%)			
	Surface Elev.: 668.4 (Ft.) ELEVATION (Ft.)													LL-PL-PI
	0.3 <b>ASPHALT PAVEMENT</b>	668												
	1.3 <b>GRANULAR BASE</b>	667												
	<b>FILL - LEAN CLAY (CL)</b>													
	4.0	664.5												
	<b>LEAN CLAY (CL)</b> , with sand, trace gravel, brown, stiff to very stiff													
	5													
	8.0	660.5												
	<b>POORLY GRADED SAND (SP)</b> , with clay, trace gravel, brown, very loose													
	11.0	657.5												
	<b>LEAN CLAY (CL)</b> , brown, very stiff, with rock fragments													
	13.5	655												
	<b>LEAN CLAY (CL)</b> , with gravel, trace sand, brown, very stiff													
	15													
	18.5	650												
	<b>LEAN CLAY (CL)</b> , with sand, with gravel, gray, very stiff to hard, (GLACIAL TILL)													
	20													
	25													
	30													

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:  
3.25" Hollow Stem Auger

See Exhibit A-4 for description of field procedures

Notes:

Abandonment Method:  
Borings backfilled with soil cuttings upon completion.

See Appendix B for description of laboratory procedures and additional data (if any).  
See Appendix C for explanation of symbols and abbreviations.

## WATER LEVEL OBSERVATIONS

No water observed during or after drilling.

**Terracon**  
611 Lunken Park Drive  
Cincinnati, Ohio

Boring Started: 3/29/2013

Boring Completed: 4/2/2013

Drill Rig: Track

Driller: Moore

Project No.: N1135044

Exhibit: A-7

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL N1135044 TEST BORING LOGS.GPJ TERRACON2012.GDT 4/26/13

# BORING LOG NO. SPD-2

Page 2 of 2

PROJECT: VAMC SPD Addition

CLIENT: John Poe Architects

SITE: 17273 State Route 104  
Chillicothe, Ohio

ELEVATION REFERENCE:  
Survey Grade GPS Unit

GRAPHIC LOG	LOCATION See Exhibit A-2	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	Loss on Ignition	LABORATORY TORVANE/HP (psf)	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS
									TEST TYPE	COMPRESSIVE STRENGTH (psf)	STRAIN (%)			
	Surface Elev.: 668.4 (Ft.) DEPTH ELEVATION (Ft.)													LL-PL-PI
	<b>LEAN CLAY (CL)</b> , with sand, with gravel, gray, very stiff to hard, (GLACIAL TILL) <i>(continued)</i>	35		X	100	9-16-16 N=32		3.5 (HP)				13		
		40		X	100	9-15-16 N=31		4.5 (HP)				12		
		45		X	100	9-15-16 N=31		2.5 (HP)				10		
		48.5		X	100	40-40-44 N=84								
	<b>SAND AND GRAVEL (SP)</b> , trace clay, very dense	50		X	100	15-18-19 N=37								
		53.5		X	100	16-19-20 N=39								
	<b>POORLY GRADED SAND (SP)</b> , trace gravel, brown, dense	55		X	100									
		58.5		X	100									
	<b>POORLY GRADED SAND (SP)</b> , with clay, trace gravel, gray, dense	60		X	100									
		63.5		X	100									
	<b>Boring Terminated at 63.5 Feet</b>				0	50/0" N=50/0"								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:  
3.25" Hollow Stem Auger

See Exhibit A-4 for description of field procedures

Notes:

Abandonment Method:  
Borings backfilled with soil cuttings upon completion.

See Appendix B for description of laboratory procedures and additional data (if any).  
See Appendix C for explanation of symbols and abbreviations.

## WATER LEVEL OBSERVATIONS

No water observed during or after drilling.

**Terracon**  
611 Lunken Park Drive  
Cincinnati, Ohio

Boring Started: 3/29/2013

Boring Completed: 4/2/2013

Drill Rig: Track

Driller: Moore

Project No.: N1135044

Exhibit: A-8

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL N1135044 TEST BORING LOGS.GPJ TERRACON2012.GDT 4/26/13

# BORING LOG NO. SPD-3

Page 1 of 3

PROJECT: VAMC SPD Addition

CLIENT: John Poe Architects

SITE: 17273 State Route 104  
Chillicothe, Ohio

ELEVATION REFERENCE:  
Survey Grade GPS Unit

GRAPHIC LOG	LOCATION See Exhibit A-2	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	Loss on Ignition	LABORATORY TORVANE/HP (psf)	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS
									TEST TYPE	COMPRESSIVE STRENGTH (psf)	STRAIN (%)			
	Surface Elev.: 671.1 (Ft.)													
	DEPTH ELEVATION (Ft.)													
	0.3 <b>TOPSOIL (4")</b> 671													
	<b>FILL - LEAN CLAY (CL)</b> , trace sand, trace gravel, brown and dark brown, trace roots 669			X	100	3-4-5 N=9		3.0 (HP)				26		
	<b>SANDY LEAN CLAY (CL)</b> , brown, medium stiff			X	100	3-4-5 N=9		0.75 (HP)				21		33-16-17
	6.0 <b>LEAN CLAY (CL)</b> , trace sand, trace gravel, trace sand and silt seams, brown, stiff to very stiff, (GLACIAL TILL) 665			X	100	2-3-3 N=6		3.25 (HP)				19		
				X	100	2-3-3 N=6		3.0 (HP)				14		
	12.0 <b>LEAN CLAY (CL)</b> , trace sand, trace fine to coarse gravel, gray, very stiff to hard, (GLACIAL TILL) 659			X	100	2-2-3 N=5		1.75 (HP)				14		
	-trace silt and sand seams			X	100	0-6-7 N=13		3.5 (HP)						
				X	100	8-9-12 N=21		4.5 (HP)				13		
				X	100	9-13-21 N=34								
				X	100	9-10-15 N=25		4.5 (HP)						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:  
3.25" Hollow Stem Auger

See Exhibit A-4 for description of field procedures

Notes:

Abandonment Method:  
Borings backfilled with soil cuttings upon completion.

See Appendix B for description of laboratory procedures and additional data (if any).  
See Appendix C for explanation of symbols and abbreviations.

## WATER LEVEL OBSERVATIONS

- Water observed at 62 ft. during drilling
- Water observed at 5 ft. after drilling

**Terracon**  
611 Lunken Park Drive  
Cincinnati, Ohio

Boring Started: 3/28/2013

Boring Completed: 3/28/2013

Drill Rig: Track

Driller: Moore

Project No.: N1135044

Exhibit: A-9

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL N1135044 TEST BORING LOGS.GPJ TERRACON2012.GDT 4/26/13

# BORING LOG NO. SPD-3

Page 2 of 3

PROJECT: VAMC SPD Addition

CLIENT: John Poe Architects

SITE: 17273 State Route 104  
Chillicothe, Ohio

ELEVATION REFERENCE:  
Survey Grade GPS Unit

GRAPHIC LOG	LOCATION See Exhibit A-2	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	Loss on Ignition	LABORATORY TORVANE/HP (psf)	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS
									TEST TYPE	COMPRESSIVE STRENGTH (psf)	STRAIN (%)			
	Surface Elev.: 671.1 (Ft.) DEPTH ELEVATION (Ft.)													LL-PL-PI
	<b>LEAN CLAY (CL)</b> , trace sand, trace fine to coarse gravel, gray, very stiff to hard, (GLACIAL TILL) -trace silt and sand seams (continued)	35		X	100	8-13-16 N=29		4.0 (HP)				15		
	<b>SILTY SAND (SM)</b> , trace gravel, fine to coarse grained, brown, dense	40		X	100	17-24-23 N=47								
	<b>SILTY SAND (SM)</b> , trace gravel, fine grained, brown, dense to very dense	45		X	100	21-31-42 N=73								
		50		X	100	19-24-22 N=46								
		55		X	100	18-19-23 N=42								
	<b>WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)</b> , brown, dense to very dense	60		X	100	23-38-23 N=61								
		65		X	100	24-31-30 N=61								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:  
3.25" Hollow Stem Auger

See Exhibit A-4 for description of field procedures

Notes:

Abandonment Method:  
Borings backfilled with soil cuttings upon completion.

See Appendix B for description of laboratory procedures and additional data (if any).  
See Appendix C for explanation of symbols and abbreviations.

## WATER LEVEL OBSERVATIONS

- Water observed at 62 ft. during drilling
- Water observed at 5 ft. after drilling

**Terracon**  
611 Lunken Park Drive  
Cincinnati, Ohio

Boring Started: 3/28/2013

Boring Completed: 3/28/2013

Drill Rig: Track

Driller: Moore

Project No.: N1135044

Exhibit: A-10

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL N1135044 TEST BORING LOGS.GPJ TERRACON2012.GDT 4/26/13



# BORING LOG NO. SPD-3

Page 3 of 3

PROJECT: VAMC SPD Addition

CLIENT: John Poe Architects

SITE: 17273 State Route 104  
Chillicothe, Ohio

ELEVATION REFERENCE:  
Survey Grade GPS Unit

GRAPHIC LOG	LOCATION See Exhibit A-2	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	Loss on Ignition	LABORATORY TORVANE/HP (psf)	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS
									TEST TYPE	COMPRESSIVE STRENGTH (psf)	STRAIN (%)			
	Surface Elev.: 671.1 (Ft.) DEPTH ELEVATION (Ft.)													LL-PL-PI
	<b>WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)</b> , brown, dense to very dense ( <i>continued</i> )													
	70.0 601	70		X	100	13-25-26 N=51								
	<b>Boring Terminated at 70 Feet</b>													

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:  
3.25" Hollow Stem Auger

See Exhibit A-4 for description of field procedures

Notes:

Abandonment Method:  
Borings backfilled with soil cuttings upon completion.

See Appendix B for description of laboratory  
procedures and additional data (if any).  
See Appendix C for explanation of symbols and  
abbreviations.

## WATER LEVEL OBSERVATIONS

- Water observed at 62 ft. during drilling
- Water observed at 5 ft. after drilling

**Terracon**  
611 Lunken Park Drive  
Cincinnati, Ohio

Boring Started: 3/28/2013

Boring Completed: 3/28/2013

Drill Rig: Track

Driller: Moore

Project No.: N1135044

Exhibit: A-11



# BORING LOG NO. SPD-4

Page 2 of 2

PROJECT: VAMC SPD Addition

CLIENT: John Poe Architects

SITE: 17273 State Route 104  
Chillicothe, Ohio

ELEVATION REFERENCE:  
Survey Grade GPS Unit

GRAPHIC LOG	LOCATION See Exhibit A-2	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	Loss on Ignition	LABORATORY TORVANE/HP (psf)	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS
									TEST TYPE	COMPRESSIVE STRENGTH (psf)	STRAIN (%)			
	Surface Elev.: 670.6 (Ft.) DEPTH ELEVATION (Ft.)													LL-PL-PI
	<b>LEAN CLAY (CL)</b> , with sand, with gravel, with silt seams, gray, very stiff to hard, (GLACIAL TILL) <i>(continued)</i>	35		X	100	12-13-19 N=32		4.5 (HP)				12		
		40		X	33	10-18-37 N=55		3.5 (HP)	UC	9819	9.6	12	96	
	<b>SAND AND GRAVEL (SP)</b> , brown, dense	45		X	100	13-17-16 N=33						10		
		50		X	100	16-19-22 N=41								
	<b>Boring Terminated at 50 Feet</b>													

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:  
3.25" Hollow Stem Auger

See Exhibit A-4 for description of field procedures

Notes:

Abandonment Method:  
Borings backfilled with soil cuttings upon completion.

See Appendix B for description of laboratory procedures and additional data (if any).  
See Appendix C for explanation of symbols and abbreviations.

## WATER LEVEL OBSERVATIONS

Water observed at 41 ft. after 24 hrs

**Terracon**  
611 Lunken Park Drive  
Cincinnati, Ohio

Boring Started: 3/26/2013

Boring Completed: 3/26/2013

Drill Rig: Track

Driller: Moore

Project No.: N1135044

Exhibit: A-13

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL N1135044 TEST BORING LOGS.GPJ TERRACON2012.GDT 4/26/13

# BORING LOG NO. SPD-5

Page 1 of 2

PROJECT: VAMC SPD Addition

CLIENT: John Poe Architects

SITE: 17273 State Route 104  
Chillicothe, Ohio

ELEVATION REFERENCE:  
Survey Grade GPS Unit

GRAPHIC LOG	LOCATION See Exhibit A-2	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	Loss on Ignition	LABORATORY TORVANE/HP (psf)	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS
									TEST TYPE	COMPRESSIVE STRENGTH (psf)	STRAIN (%)			
	Surface Elev.: 672.2 (Ft.)													LL-PL-PI
	DEPTH ELEVATION (Ft.)													
	0.3 TOPSOIL (4") 672		▼											
	LEAN CLAY (CL), trace sand, mottled brown with dark brown, stiff, trace root hairs 669	3.0		X	100	3-4-3 N=7		2.0 (HP)				26		
	SANDY LEAN CLAY (CL), trace gravel, brown, medium stiff 666.5	5.5		X	100	4-4-6 N=10		1.0 (HP)				19		
	LEAN CLAY (CL), with sand, trace gravel, brown, very stiff to hard, (GLACIAL TILL)			X	33	5-6-6 N=12		4.5 (HP)				16		
				X	100	3-4-5 N=9		3.75 (HP)				34		
	LEAN CLAY (CL), trace sand, trace fine to coarse gravel, brown with gray, medium stiff to stiff, (GLACIAL TILL)	12.0	▽	X	100	3-3-3 N=6		3.25 (HP)				20		
	-trace sand seams and pockets			X	100	1-1-1 N=2		1.75 (HP)				13		
	SILTY CLAY (CL-ML), with sand, with gravel, gray, very stiff to hard, (GLACIAL TILL)	19.0		X	100	3-4-4 N=8		1.0 (HP)				14		
	-trace sand seams													
				X	100	10-10-11 N=21		2.5 (HP)				9		20-14-6
				X	100	2-3-6 N=9		3.5 (HP)						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:  
3.25" Hollow Stem Auger

See Exhibit A-4 for description of field procedures

Notes:

See Appendix B for description of laboratory procedures and additional data (if any).  
See Appendix C for explanation of symbols and abbreviations.

Abandonment Method:  
Borings backfilled with soil cuttings upon completion.

## WATER LEVEL OBSERVATIONS

▽ Water observed at 12 ft. during drilling

▼ Water observed at 1 ft. after 24 hrs

**Terracon**  
611 Lunken Park Drive  
Cincinnati, Ohio

Boring Started: 3/27/2013

Boring Completed: 3/27/2013

Drill Rig: Track

Driller: Moore

Project No.: N1135044

Exhibit: A-14

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL N1135044 TEST BORING LOGS.GPJ TERRACON2012.GDT 4/26/13

# BORING LOG NO. SPD-5

Page 2 of 2

PROJECT: VAMC SPD Addition

CLIENT: John Poe Architects

SITE: 17273 State Route 104  
Chillicothe, Ohio

ELEVATION REFERENCE:  
Survey Grade GPS Unit

GRAPHIC LOG	LOCATION See Exhibit A-2	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	Loss on Ignition	LABORATORY TORVANE/HP (psf)	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS
									TEST TYPE	COMPRESSIVE STRENGTH (psf)	STRAIN (%)			
	Surface Elev.: 672.2 (Ft.) DEPTH ELEVATION (Ft.)													LL-PL-PI
	<b>SILTY CLAY (CL-ML)</b> , with sand, with gravel, gray, very stiff to hard, (GLACIAL TILL)  -trace sand seams ( <i>continued</i> )	35		X	100	5-7-8 N=15		4.5 (HP)				14		
		40		X	100	6-7-8 N=15		4.5 (HP)						
		45		X	100	3-4-7 N=11		3.0 (HP)				14		
	48.0 624													
	<b>SILTY SAND (SM)</b> , brown, very loose, trace silt seams	50		X	39	0-0-0 N=0								
		55		X	100	1-1-2 N=3								
	55.0 617													
	<b>WELL GRADED SAND (SW)</b> , trace silt, trace gravel, brown, dense	60		X	100	10-31-35 N=66								
	60.0 612													
	<b>Boring Terminated at 60 Feet</b>	60												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:  
3.25" Hollow Stem Auger

See Exhibit A-4 for description of field procedures

Notes:

Abandonment Method:  
Borings backfilled with soil cuttings upon completion.

See Appendix B for description of laboratory procedures and additional data (if any).  
See Appendix C for explanation of symbols and abbreviations.

## WATER LEVEL OBSERVATIONS

Water observed at 12 ft. during drilling

Water observed at 1 ft. after 24 hrs

**Terracon**  
611 Lunken Park Drive  
Cincinnati, Ohio

Boring Started: 3/27/2013

Boring Completed: 3/27/2013

Drill Rig: Track

Driller: Moore

Project No.: N1135044

Exhibit: A-15

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL N1135044 TEST BORING LOGS.GPJ TERRACON2012.GDT 4/26/13

# BORING LOG NO. SPD-6

Page 1 of 3

PROJECT: VAMC SPD Addition

CLIENT: John Poe Architects

SITE: 17273 State Route 104  
Chillicothe, Ohio

ELEVATION REFERENCE:  
Survey Grade GPS Unit

GRAPHIC LOG	LOCATION See Exhibit A-2	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	Loss on Ignition	LABORATORY TORVANE/HP (psf)	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS
									TEST TYPE	COMPRESSIVE STRENGTH (psf)	STRAIN (%)			
	Surface Elev.: 673.7 (Ft.)													LL-PL-PI
	DEPTH ELEVATION (Ft.)													
	0.2 TOPSOIL (2") 673.5													
	FILL - LEAN CLAY (CL), with sand, trace gravel, brown, trace rock fragments			X	100	3-4-8 N=12		2.5 (HP)						
	-trace sand seams below 3.5'													
	6.0 667.5	5		X	100	10-13-10 N=23		4.0 (HP)				16		
	SANDY LEAN CLAY (CL), dark brown to brown, medium stiff			X	100	4-4-5 N=9		0.75 (HP)						
		10		X	33	2-3-5 N=8		1.0 (HP)				17		
					50									
	12.0 661.5													
	LEAN CLAY (CL), with sand, trace gravel, brown, stiff to hard, (GLACIAL TILL)			X	100	3-4-7 N=11		4.5 (HP)						
		15			50					3389	10.8	18	117	31-15-16
	18.5 655			X	100	10-16-17 N=33		4.5 (HP)						
	LEAN CLAY (CL), with sand, with gravel, gray, hard, (GLACIAL TILL)													
		20												
				X	100	12-17-30 N=47								
		25												
				X	100	17-12-14 N=26		4.5 (HP)				10		
		30												
	33.0 640.5													

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:  
3.25" Hollow Stem Auger

See Exhibit A-4 for description of field procedures

Notes:

Abandonment Method:  
Borings backfilled with soil cuttings upon completion.

See Appendix B for description of laboratory procedures and additional data (if any).  
See Appendix C for explanation of symbols and abbreviations.

## WATER LEVEL OBSERVATIONS

- Water observed at 22 ft. during drilling
- Water observed at 8 ft. after drilling

**Terracon**  
611 Lunken Park Drive  
Cincinnati, Ohio

Boring Started: 3/27/2013

Boring Completed: 3/27/2013

Drill Rig: Track

Driller: Moore

Project No.: N1135044

Exhibit: A-16

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL N1135044 TEST BORING LOGS.GPJ TERRACON2012.GDT 4/26/13

# BORING LOG NO. SPD-6

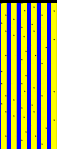

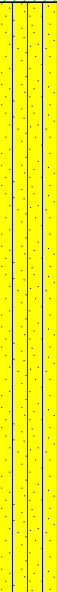
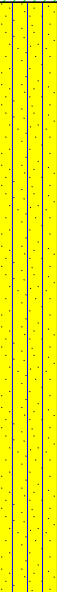
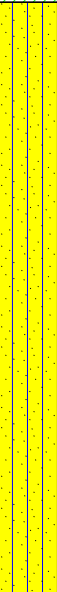
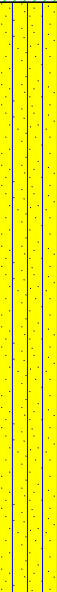

Page 2 of 3

PROJECT: VAMC SPD Addition

CLIENT: John Poe Architects

SITE: 17273 State Route 104  
Chillicothe, Ohio

ELEVATION REFERENCE:  
Survey Grade GPS Unit

GRAPHIC LOG	LOCATION See Exhibit A-2	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	Loss on Ignition	LABORATORY TORVANE/HP (psf)	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS
									TEST TYPE	COMPRESSIVE STRENGTH (psf)	STRAIN (%)			
	Surface Elev.: 673.7 (Ft.) DEPTH ELEVATION (Ft.)													LL-PL-PI
	<b>SANDY SILT (ML)</b> , brown and gray, dense	35		X	100	10-18-16 N=34								
	<b>LEAN CLAY (CL)</b> , with sand, trace gravel, gray, very stiff to hard, (GLACIAL TILL)	40		X	100	17-30-36 N=66		4.5 (HP)				12		
	<b>SILTY SAND (SM)</b> , brown, dense, -with gravel below 58 feet	45		X	100	10-2-3 N=5		3.5 (HP)						
		50		X	100	17-30-36 N=66								
		55		X	100	21-19-13 N=32								
		60		X	100	10-31-50/5" N=50/5"								
	<b>LEAN CLAY (CL)</b> , trace sand, trace gravel, brown and gray, hard, trace rock fragments, (GLACIAL TILL)	65		X	100	32-46-54 N=100		4.5 (HP)				8		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:  
3.25" Hollow Stem Auger



See Exhibit A-4 for description of field procedures

Notes:

Abandonment Method:  
Borings backfilled with soil cuttings upon completion.

See Appendix B for description of laboratory procedures and additional data (if any).  
See Appendix C for explanation of symbols and abbreviations.

## WATER LEVEL OBSERVATIONS

-  Water observed at 22 ft. during drilling
-  Water observed at 8 ft. after drilling

**Terracon**  
611 Lunken Park Drive  
Cincinnati, Ohio

Boring Started: 3/27/2013

Boring Completed: 3/27/2013

Drill Rig: Track

Driller: Moore

Project No.: N1135044

Exhibit: A-17

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL N1135044 TEST BORING LOGS.GPJ TERRACON2012.GDT 4/26/13

# BORING LOG NO. SPD-6

Page 3 of 3

PROJECT: VAMC SPD Addition

CLIENT: John Poe Architects

SITE: 17273 State Route 104  
Chillicothe, Ohio

ELEVATION REFERENCE:  
Survey Grade GPS Unit

GRAPHIC LOG	LOCATION See Exhibit A-2	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	Loss on Ignition	LABORATORY TORVANE/HP (psf)	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS
									TEST TYPE	COMPRESSIVE STRENGTH (psf)	STRAIN (%)			
	Surface Elev.: 673.7 (Ft.)													
	DEPTH ELEVATION (Ft.)													LL-PL-PI
	68.0 605.5													
	<b>POORLY GRADED SAND (SP),</b> with fine gravel, coarse grained, gray, dense to very dense	70.0 603.5			100	14-26-42 N=68								
	<b>Boring Terminated at 70 Feet</b>	70												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:  
3.25" Hollow Stem Auger

See Exhibit A-4 for description of field procedures

Notes:

Abandonment Method:  
Borings backfilled with soil cuttings upon completion.

See Appendix B for description of laboratory procedures and additional data (if any).  
See Appendix C for explanation of symbols and abbreviations.

## WATER LEVEL OBSERVATIONS

- Water observed at 22 ft. during drilling
- Water observed at 8 ft. after drilling

**Terracon**  
611 Lunken Park Drive  
Cincinnati, Ohio

Boring Started: 3/27/2013

Boring Completed: 3/27/2013

Drill Rig: Track

Driller: Moore

Project No.: N1135044

Exhibit: A-18



# BORING LOG NO. SPD-7

Page 1 of 2

PROJECT: VAMC SPD Addition

CLIENT: John Poe Architects

SITE: 17273 State Route 104  
Chillicothe, Ohio

ELEVATION REFERENCE:  
Survey Grade GPS Unit

GRAPHIC LOG	LOCATION See Exhibit A-2	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	Loss on Ignition	LABORATORY TORVANE/HP (psf)	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS
									TEST TYPE	COMPRESSIVE STRENGTH (psf)	STRAIN (%)			
	Surface Elev.: 669.7 (Ft.)													LL-PL-PI
	DEPTH ELEVATION (Ft.)													
	0.3 <b>TOPSOIL (4")</b> 669.5													
	<b>FILL - LEAN CLAY (CL)</b> , trace sand, dark brown			X	33	3-5-7 N=12		3.0 (HP)				24		
	3.0 666.5													
	<b>SANDY LEAN CLAY (CL)</b> , mottled dark brown and brown, stiff			X	100	5-5-5 N=10		1.5 (HP)				17		
	5.5 664													
	<b>LEAN CLAY (CL)</b> , trace sand, trace fine to coarse gravel, brown, very stiff to hard, (GLACIAL TILL)			X	100	5-6-8 N=14		3.0 (HP)				13		
	-trace wet sand seams below 13 ft.													
				X	100	5-8-2 N=10		4.5 (HP)				16		
				X	11	18-15-15 N=30								
				X	100	17-25-32 N=57								
	17.0 652.5													
	<b>LEAN CLAY (CL)</b> , trace sand, trace fine to coarse gravel, gray, very stiff to hard, (GLACIAL TILL)		▽											
	-trace wet sand seams below 23 ft.			X	100	12-19-25 N=44		4.5 (HP)						
			▽											
				X	100	14-15-16 N=31		4.0 (HP)						
				X	100	12-15-16 N=31								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:  
3.25" Hollow Stem Auger

See Exhibit A-4 for description of field procedures

Notes:

See Appendix B for description of laboratory procedures and additional data (if any).

Abandonment Method:  
Borings backfilled with soil cuttings upon completion.

See Appendix C for explanation of symbols and abbreviations.

## WATER LEVEL OBSERVATIONS

- ▽ Water observed at 18 ft. during drilling
- ▽ Water observed at 23 ft. after drilling

**Terracon**  
611 Lunken Park Drive  
Cincinnati, Ohio

Boring Started: 3/28/2013

Boring Completed: 3/28/2013

Drill Rig: Track

Driller: Moore

Project No.: N1135044

Exhibit: A-19

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL N1135044 TEST BORING LOGS.GPJ TERRACON2012.GDT 4/26/13

# BORING LOG NO. SPD-7

Page 2 of 2

PROJECT: VAMC SPD Addition

CLIENT: John Poe Architects

SITE: 17273 State Route 104  
Chillicothe, Ohio

ELEVATION REFERENCE:  
Survey Grade GPS Unit

GRAPHIC LOG	LOCATION See Exhibit A-2	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	Loss on Ignition	LABORATORY TORVANE/HP (psf)	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS
									TEST TYPE	COMPRESSIVE STRENGTH (psf)	STRAIN (%)			
	Surface Elev.: 669.7 (Ft.) DEPTH ELEVATION (Ft.)													LL-PL-PI
	<b>LEAN CLAY (CL)</b> , trace sand, trace fine to coarse gravel, gray, very stiff to hard, (GLACIAL TILL)  -trace wet sand seams below 23 ft. (continued)	35		X	100	12-16-19 N=35		3.5 (HP)				14		
	38.0 631.5													
	<b>SILTY SAND (SM)</b> , brown, dense	40		X	100	13-15-17 N=32								
	43.0 626.5													
	<b>LEAN CLAY (CL)</b> , trace sand, trace gravel, gray with brown, very stiff, trace rock fragments	45		X	100	11-13-22 N=35		3.5 (HP)				16		
	47.0 622.5													
	<b>SILTY SAND (SM)</b> , fine grained, brown, very dense	50		X	100	12-21-37 N=58								
	50.0 619.5													
	<b>Boring Terminated at 50 Feet</b>													

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:  
3.25" Hollow Stem Auger

See Exhibit A-4 for description of field procedures

Notes:

Abandonment Method:  
Borings backfilled with soil cuttings upon completion.

See Appendix B for description of laboratory procedures and additional data (if any).  
See Appendix C for explanation of symbols and abbreviations.

## WATER LEVEL OBSERVATIONS

- Water observed at 18 ft. during drilling
- Water observed at 23 ft. after drilling

**Terracon**  
611 Lunken Park Drive  
Cincinnati, Ohio

Boring Started: 3/28/2013

Boring Completed: 3/28/2013

Drill Rig: Track

Driller: Moore

Project No.: N1135044

Exhibit: A-20

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL N1135044 TEST BORING LOGS.GPJ TERRACON2012.GDT 4/26/13

# BORING LOG NO. L-1

Page 1 of 2

**PROJECT: VAMC Lab/Prosthetics Building**

**CLIENT: John Poe Architects**

**SITE: 17273 State Route 104  
Chillicothe, Ohio**

GRAPHIC LOG	LOCATION See Exhibit A-2	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	Loss on Ignition	LABORATORY TORVANE/HP (psf)	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS
									TEST TYPE	COMPRESSIVE STRENGTH (psf)	STRAIN (%)			
	Surface Elev.: 668.3 (Ft.) DEPTH ELEVATION (Ft.)													LL-PL-PI
	<b>FILL - LEAN CLAY (CL)</b> , trace sand, brown	3.5			67	5-5-8 N=13		1.75 (HP)				28		
	<b>LEAN CLAY (CL)</b> , with sand, brown, medium stiff, noted sand seams	5			100					1876	3.2	21	107	29-17-12
	<b>POORLY GRADED SAND (SP)</b> , with clay, brown, loose	8.5			100	4-4-5 N=9		0.75 (HP)				20		
	<b>LEAN CLAY (CL)</b> , with gravel, trace sand, gray, hard	11.0			100	2-2-3 N=5								
	<b>LEAN CLAY (CL)</b> , with gravel, trace sand, gray, hard	15			100	7-6-10 N=16		4.5 (HP)				11		
	<b>LEAN CLAY (CL)</b> , with gravel, trace sand, gray, hard	20			100	9-12-16 N=28		4.5 (HP)				9		
	<b>SANDY SILT (ML)</b> , with gravel, brown, very dense	23.5			100	10-12-10 N=22		4.5 (HP)				12		
	<b>LEAN CLAY (CL)</b> , with gravel, trace sand, gray, very stiff to hard	28.5			100	12-26-29 N=55						10		
	<b>LEAN CLAY (CL)</b> , with gravel, trace sand, gray, very stiff to hard	30			100	11-12-21 N=33		4.5 (HP)				9		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:  
3.25" Hollow Stem Auger

See Exhibit A-4 for description of field procedures

Notes:

Abandonment Method:  
Borings backfilled with soil cuttings upon completion.

See Appendix B for description of laboratory procedures and additional data (if any).  
See Appendix C for explanation of symbols and abbreviations.

## WATER LEVEL OBSERVATIONS

Water observed at 8 ft. while drilling

**Terracon**

Boring Started: 4/2/2013

Boring Completed: 4/2/2013

Drill Rig: Track

Driller: Moore

Project No.: N1125045

Exhibit: A-21

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL N1135045 TEST BORING LOGS.GPJ TERRACON2012.GDT 4/26/13

# BORING LOG NO. L-1

Page 2 of 2

**PROJECT: VAMC Lab/Prosthetics Building**

**CLIENT: John Poe Architects**

**SITE: 17273 State Route 104  
Chillicothe, Ohio**

GRAPHIC LOG	LOCATION See Exhibit A-2	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	Loss on Ignition	LABORATORY TORVANE/HP (psf)	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS
									TEST TYPE	COMPRESSIVE STRENGTH (psf)	STRAIN (%)			
	Surface Elev.: 668.3 (Ft.) DEPTH ELEVATION (Ft.)													LL-PL-PI
	<b>LEAN CLAY (CL)</b> , with gravel, trace sand, gray, very stiff to hard (continued)	35		X	100	5-9-12 N=21		4.5 (HP)				10		
		40		X	100	No record		2.0 (HP)				14		
		45		X	100	9-14-22 N=36		3.75 (HP)				15		
		50		X	100	6-12-18 N=30		3.25 (HP)				14		
	<b>Boring Terminated at 50 Feet</b>													

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:  
3.25" Hollow Stem Auger

See Exhibit A-4 for description of field procedures

Notes:

Abandonment Method:  
Borings backfilled with soil cuttings upon completion.

See Appendix B for description of laboratory procedures and additional data (if any).  
See Appendix C for explanation of symbols and abbreviations.

## WATER LEVEL OBSERVATIONS

Water observed at 8 ft. while drilling

**Terracon**

Boring Started: 4/2/2013

Boring Completed: 4/2/2013

Drill Rig: Track

Driller: Moore

Project No.: N1125045

Exhibit: A-22

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL N1135045 TEST BORING LOGS.GPJ TERRACON2012.GDT 4/26/13

## Page 1 of 2

**CLIENT:** John Poe Architects

[illegible]

Hammer Type: Automatic

Notes:

Exhibit A-23

▼ Water observed at 8.3 ft. at 72 hours

# BORING LOG NO. SB-1

Page 2 of 2

**PROJECT:** VAMC Bldg. 31 North Parking  
Lot and Sewer

**CLIENT:** John Poe Architects

**SITE:** 17273 State Route 104  
Chillicothe, Ohio

GRAPHIC LOG	LOCATION See Exhibit A-2	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY TORVANE/HP (tsf)	STRENGTH TEST			WATER CONTENT (%)	ATTERBERG LIMITS
								TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)		
	DEPTH ELEVATION (Ft.)											LL-PL-PI
	26.5	643			100	16-27-21 N=48	4.5 (HP)					
	<b>LEAN CLAY</b> , with sand, trace rock fragments, silt, brown, very stiff  <b>Boring Terminated at 26.5 Feet</b>											
		30										
		35										
		40										
		45										
		50										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:  
3.25" Hollow Stem Auger

See Exhibit A-3 for description of field procedures.  
See Appendix B for description of laboratory procedures and additional data, (if any).  
See Appendix C for explanation of symbols and abbreviations.

Notes:

Abandonment Method:  
Borings backfilled with soil cuttings upon completion.

## WATER LEVEL OBSERVATIONS

- Water observed at 25 ft. while drilling
- Water observed at 16 ft. after drilling
- Water observed at 8.3 ft. at 72 hours

**Terracon**  
611 Lunken Park Drive  
Cincinnati, Ohio

Boring Started:

Drill Rig: Track

Project No.: N1125169

Boring Completed:

Driller: Moore

Exhibit **A-24**



TesTech, Inc.  
8534 Yankee Street, Dayton, Ohio 45458  
PHONE: (937) 435-3200 FAX: (937) 291-6549

# LOG OF TEST BORING

BORING NO.: B-2 (Sheet 1/1)

CLIENT: John Poe Architects  
PROJECT: VA Building 31 Addition  
LOCATION: Chillicothe, Ohio  
PROJECT NO: 25595 DRILLER/INSP: CB SR  
BORING METHOD: HSA RIG TYPE: \_\_\_\_\_

DATE STARTED: 5-7-09 COMPLETED: 5-7-09  
TEMPERATURE/WEATHER: Cloudy, 55 Degrees  
STATION: \_\_\_\_\_ OFFSET: \_\_\_\_\_  
ELEVATION: \_\_\_\_\_ LINE: \_\_\_\_\_  
CORE SIZE: 3.25" HAMMER: \_\_\_\_\_

ELEV. (FEET)	DEPTH SCALE (FEET)	LAYER THICK- NESS	GRAPHIC LOG	SAMPLE DESCRIPTION	SAMPLE			BLOWS PER 6 INCHES	SPT N	M/C (%)	PP* (tsf)
					NO.	TYPE REC	DEPTH (FEET)				
0.8				ASPHALT.							
0.7				BASE.	1	SS	1	3-6-6	12	15.9	1.5
2				Stiff Brown Sandy CLAY FILL, trace gravel, moist (CL).			2.5				
4.1					2	SS	3.5	5-4-6	10		
5							5				
6				Medium Stiff Brown Sandy CLAY, trace gravel, moist (CL).	3	SS	6	3-3-4	7	18.3	1.25
7							7.5				
8				Stiff Dark Brown CLAY, trace sand, moist (CL).	4	SS	8.5	4-5-6	11		2.5
9							10				
11											
12											
13				Stiff Brown Sandy CLAY, few gravel, moist (CL).	5	SS	13.5	6-6-7	13	15.0	
14							15				
15						ST	17				
16											
17				Very Loose Brown GRAVEL, damp (GP).	6	SS	18.5	2-2-1	3		
18							20				
19											
20											
21											
22				Hard Gray Silty CLAY, few gravel, damp (CL).	7	SS	23.5	8-11-20	31	13.0	4.5
23							25				
24											
25											
26											
27											
28											
29					8	SS	28.5	8-15-24	39	11.6	4.5
30							30				
31				Boring Terminated at 30.0 feet							

\* Pocket Penetrometer Reading - Unconfined Compressive Strength, Tons/Sq.Ft.

## Ground Water Observations:

DATE	TIME	CASING DEPTH	CAVE-IN	BAILED	WATER LEVEL
5/7/09	9:25	18.5			19.5
5/7/09	10:00	28.5	17.0		15.0

## BORING METHOD

HSA - Hollow Stem Augers  
CFA - Continuous Flight Augers  
DC - Driving Casings  
MD - Mud Drillings

## SAMPLE TYPE

SS - Split Spoon  
ST - Shelby Tube  
CA - Continuous Auger  
RC - Rock Core  
CU - Cuttings  
CT - Continuous Tube

Remarks: \_\_\_\_\_



TesTech, Inc.  
8534 Yankee Street, Dayton, Ohio 45458  
PHONE: (937) 435-3200 FAX: (937) 291-6549

# LOG OF TEST BORING

BORING NO.: B-3 (Sheet 1/1)

CLIENT: John Poe Architects  
PROJECT: VA Building 31 Addition  
LOCATION: Chillicothe, Ohio  
PROJECT NO: 25595 DRILLER/INSP: CB SR  
BORING METHOD: HSA RIG TYPE: \_\_\_\_\_

DATE STARTED: 5-7-09 COMPLETED: 5-7-09  
TEMPERATURE/WEATHER: Cloudy, 55 Degrees  
STATION: \_\_\_\_\_ OFFSET: \_\_\_\_\_  
ELEVATION: \_\_\_\_\_ LINE: \_\_\_\_\_  
CORE SIZE: 3.25" HAMMER: \_\_\_\_\_

ELEV. (FEET)	DEPTH SCALE (FEET)	LAYER THICK- NESS	GRAPHIC LOG	SAMPLE DESCRIPTION	SAMPLE			BLOWS PER 6 INCHES	SPT N	M/C (%)	PP* (tsf)
					NO.	TYPE REC	DEPTH (FEET)				
0.7				ASPHALT.							
1	0.6			BASE.	1	SS	1	5-5-5	10	12.4	
2				Stiff Brown Sandy CLAY FILL, few gravel, moist (CL).			2.5				
3					2	SS	3.5	3-5-8	13	20.6	
4							5				
5					3	SS	6	6-5-4	9		
6				Medium Stiff Brown Sandy CLAY FILL, moist (CL).			7.5				
7					4	SS	8.5	2-4-5	9	21.4	2.0
8				Medium Stiff Reddish Brown Sandy CLAY, moist (CL).			10				
9											
10											
11											
12				Very Stiff Brown CLAY, few sand, trace gravel, damp (CL).	5	SS	13.5	6-8-12	20	14.0	3.5
13							15				
14											
15											
16											
17				Stiff Gray Silty CLAY, trace gravel, damp (CL).	6	SS	18.5	4-5-6	11		3.0
18							20				
19											
20											
21											
22											
23					7	SS	23.5	9-6-5	11	12.4	
24							25				
25											
26											
27				Hard Gray Silty CLAY, trace gravel, damp (CL).							
28					8	SS	28.5	9-13-22	35	9.5	
29							30				
30				Boring Terminated at 30.0 feet							
31											

\* Pocket Penetrometer Reading - Unconfined Compressive Strength, Tons/Sq.Ft.

## Ground Water Observations:

DATE	TIME	CASING DEPTH	CAVE-IN	BAILED	WATER LEVEL
5/7/09	11:35	28.5			NONE ▽
5/7/09	11:54	28.5	25.5		NONE ▼
					▼

## BORING METHOD

HSA - Hollow Stem Augers  
CFA - Continuous Flight Augers  
DC - Driving Casings  
MD - Mud Drillings

## SAMPLE TYPE

SS - Split Spoon  
ST - Shelby Tube  
CA - Continuous Auger  
RC - Rock Core  
CU - Cuttings  
CT - Continuous Tube

Remarks: Tried to recover Shelby Tube from 15.0' to 17.0'. Tube was crushed.

TEST\_BORING 25595.GPJ TESTTECH.GDT 6/9/09





TesTech, Inc.  
8534 Yankee Street, Dayton, Ohio 45458  
PHONE: (937) 435-3200 FAX: (937) 291-6549

# LOG OF TEST BORING

BORING NO.: B-4 (Sheet 1/1)

CLIENT: John Poe Architects  
PROJECT: VA Building 31 Addition  
LOCATION: Chillicothe, Ohio  
PROJECT NO: 25595 DRILLER/INSP: CB SR  
BORING METHOD: HSA RIG TYPE: \_\_\_\_\_

DATE STARTED: 5-6-09 COMPLETED: 5-6-09  
TEMPERATURE/WEATHER: Cloudy, 60 Degrees  
STATION: \_\_\_\_\_ OFFSET: \_\_\_\_\_  
ELEVATION: \_\_\_\_\_ LINE: \_\_\_\_\_  
CORE SIZE: 3.25" HAMMER: \_\_\_\_\_

ELEV. (FEET)	DEPTH SCALE (FEET)	LAYER THICK- NESS	GRAPHIC LOG	SAMPLE DESCRIPTION	SAMPLE			BLOWS PER 6 INCHES	SPT N	M/C (%)	PP* (tsf)
					NO.	TYPE REC	DEPTH (FEET)				
		0.8		TOPSOIL.							
1				Medium Stiff Reddish Brown Sandy CLAY FILL, few gravel, moist (CL).	1		1 2.5	3-3-3	6	15.6	
2		2.2									
3				Soft Reddish Brown Sandy CLAY FILL, few gravel, trace organics, moist (CL).	2		3.5 5	3-2-3	5	17.3	
4		2.5									
5				Very Stiff Reddish Brown Sandy CLAY, moist (CL).	3		6 7.5	5-7-10	17		2.75
6		2.5									
7				Stiff Brown Sandy CLAY, trace gravel, moist (CL).	4		8.5 10	5-5-6	11	18.1	
8											
9		4.0									
10				Soft Brown Sandy CLAY, few gravel, moist (CL).							
11											
12											
13											
14		5.0			5		13.5 15	4-2-3	5		0.75
15											
16											
17				Very Stiff Gray Silty CLAY, trace gravel, damp (CL).							
18											
19		5.0			6		18.5 20	7-12-14	26	10.6	4.5+
20											
21											
22				Hard Gray Silty CLAY, trace gravel, damp (CL).							
23											
24		5.0			7		23.5 25	7-12-19	31	10.1	
25											
26											
27				Very Stiff Gray Silty CLAY, trace gravel, damp (CL).							
28											
29		3.0			8		28.5 30	6-13-16	29	11.1	4.5+
30				Boring Terminated at 30.0 feet							
31											

\* Pocket Penetrometer Reading - Unconfined Compressive Strength, Tons/Sq.Ft.

## Ground Water Observations:

DATE	TIME	CASING DEPTH	CAVE-IN	BAILED	WATER LEVEL
5/6/09	12:10	28.5			NONE
5/6/09	12:25	28.5	25.3		NONE

## BORING METHOD

HSA - Hollow Stem Augers  
CFA - Continuous Flight Augers  
DC - Driving Casings  
MD - Mud Drillings

## SAMPLE TYPE

SS - Split Spoon  
ST - Shelby Tube  
CA - Continuous Auger  
RC - Rock Core  
CU - Cuttings  
CT - Continuous Tube

Remarks: Tried to recover Shelby Tube from 20.0' to 22.0'. Tube was crushed.

**APPENDIX B**  
**LABORATORY TESTING**

**Geotechnical Engineering Report**

SPD Addition to Building 31 ■ Chillicothe, Ohio

April 26, 2013 ■ HCN/Terracon Project No. N1135044

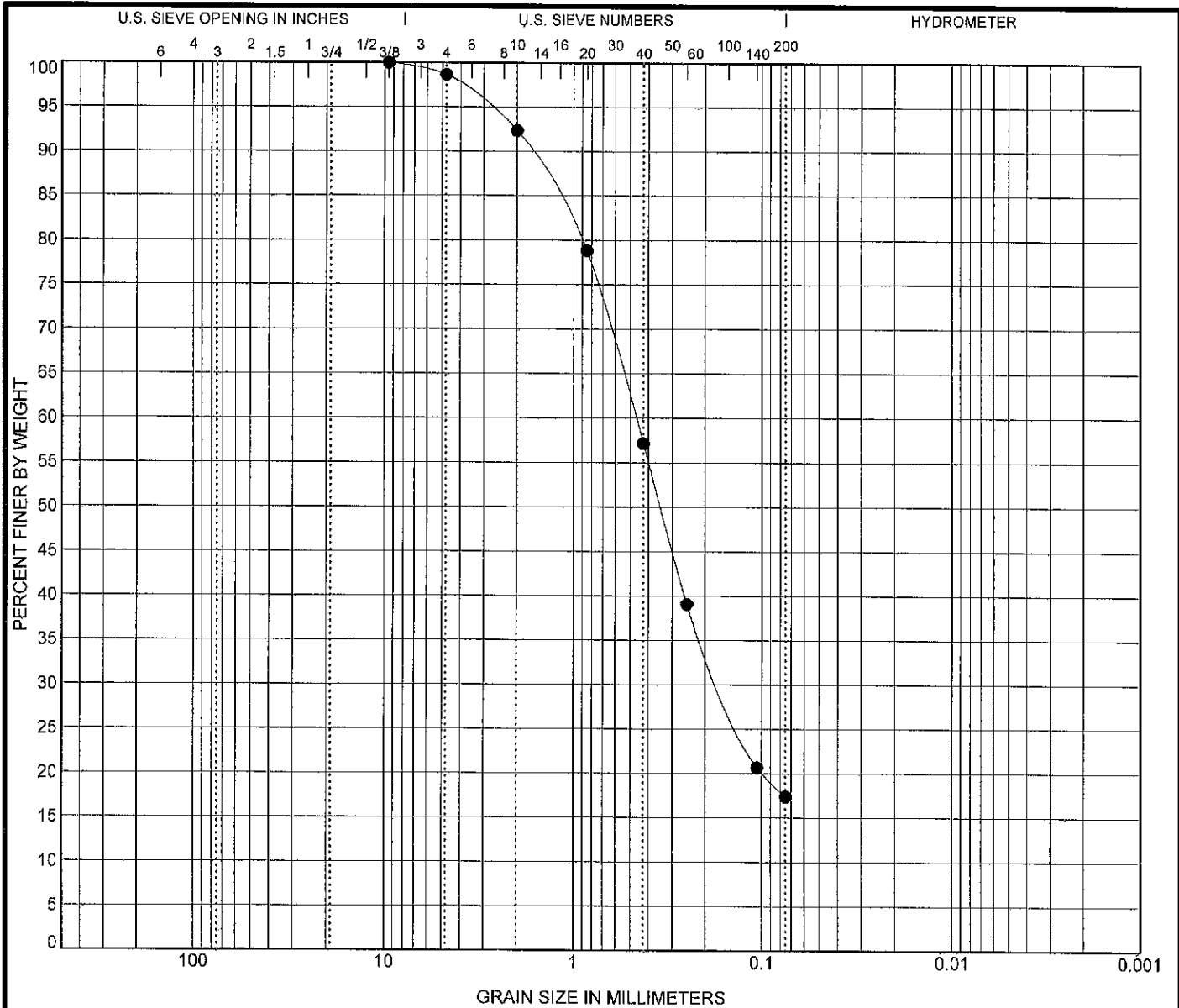
**Laboratory Testing**

Selected soil samples were tested in the laboratory to measure natural water content, organic content, grain-size distribution and Atterberg Limits. Unconfined compression tests were performed on selected soil samples and a hand penetrometer was used to estimate the approximate unconfined compression tests of selected soil samples. The hand penetrometer has been correlated with unconfined compression tests and provides a better estimate of soil consistency than visual examination alone. A one-dimensional consolidation test was performed on a relatively undisturbed Shelby tube sample collected at a depth of 3 to 5 feet below existing grade from Boring SPD-1. The test results are provided on the boring logs included in Appendix A and this Appendix. Plots of the unconfined compression test and the one-dimensional consolidation test results are attached in this Appendix.

Descriptive classifications of the soils and bedrock indicated on the boring logs are in accordance with the enclosed General Notes, the Unified Soil Classification System, and Description of Rock Properties included in Appendix C. Also shown are estimated Unified Soil Classification Symbols. A brief description of this classification system is included in Appendix C of this report. All classification was by visual-manual procedures. Selected samples were further classified using the results of Atterberg Limits testing. The Atterberg Limit tests results are also provided on the boring logs.

# GRAIN SIZE DISTRIBUTION

ASTM D422



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID		Depth	USCS Classification				LL	PL	PI	Cc	Cu
●	SPD-3	53.5	LT BROWN SILTY CLAYEY SAND								
Boring ID		Depth	D <sub>100</sub>	D <sub>60</sub>	D <sub>30</sub>	D <sub>10</sub>	%Gravel	%Sand	%Silt	%Clay	
●	SPD-3	53.5	9.5	0.466	0.164		1.3	81.3	17.4		

PROJECT: VAMC SPD Addition

SITE: 17273 State Route 104  
Chillicothe, Ohio

**Terracon**

611 Lunken Park Drive  
Cincinnati, Ohio

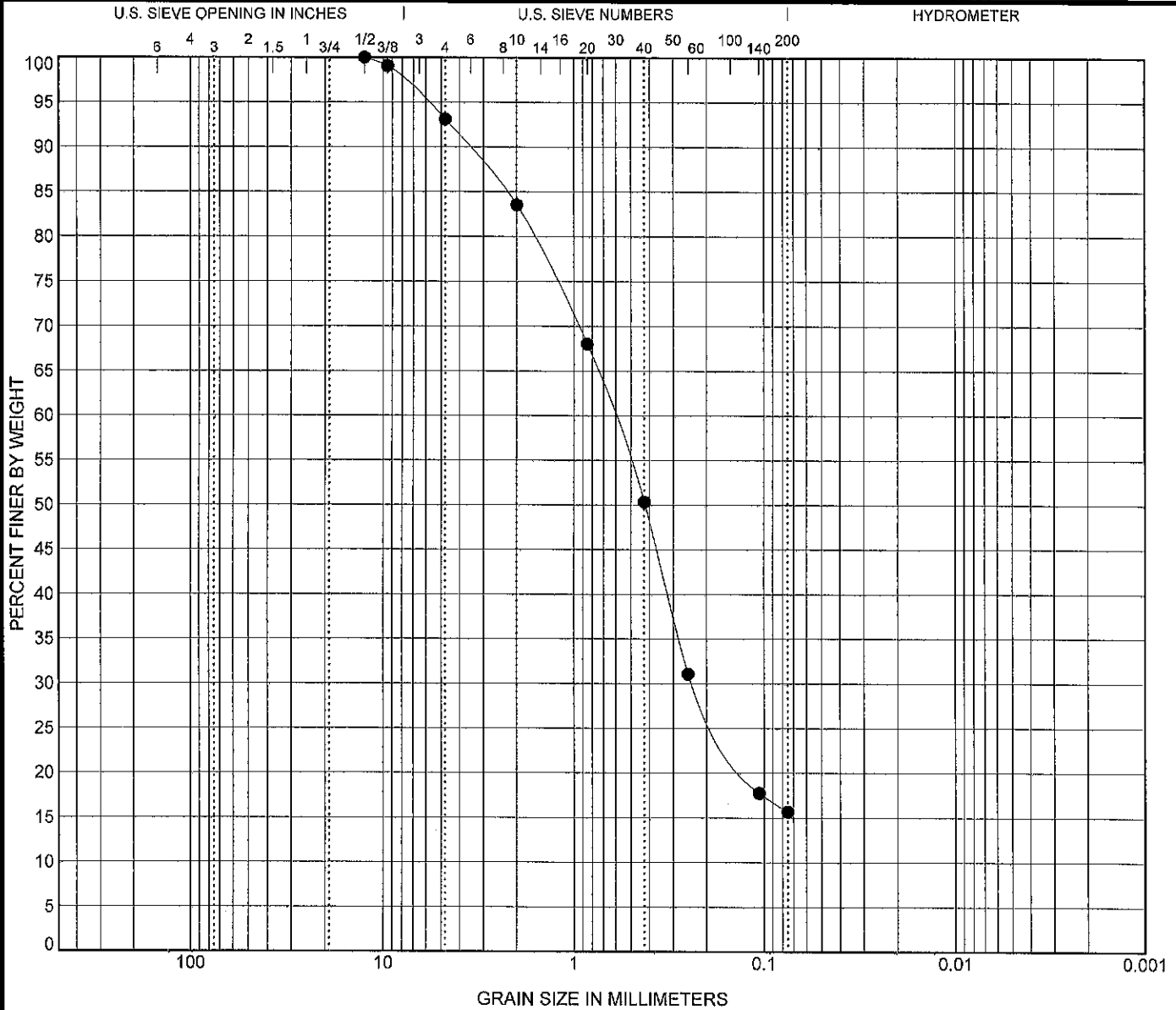
PROJECT NUMBER: N1135044

CLIENT: John Poe Architects

EXHIBIT B-2

# GRAIN SIZE DISTRIBUTION

ASTM D422



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID		Depth	USCS Classification					LL	PL	PI	Cc	Cu
●	SPD-5	48.5	BROWN SILTY CLAYEY SAND									
Boring ID		Depth	D <sub>100</sub>	D <sub>60</sub>	D <sub>30</sub>	D <sub>10</sub>	%Gravel	%Sand	%Silt	%Clay		
●	SPD-5	48.5	12.5	0.621	0.233		6.9	77.4	15.7			

PROJECT: VAMC SPD Addition

SITE: 17273 State Route 104  
Chillicothe, Ohio

**Terracon**

611 Lunken Park Drive  
Cincinnati, Ohio

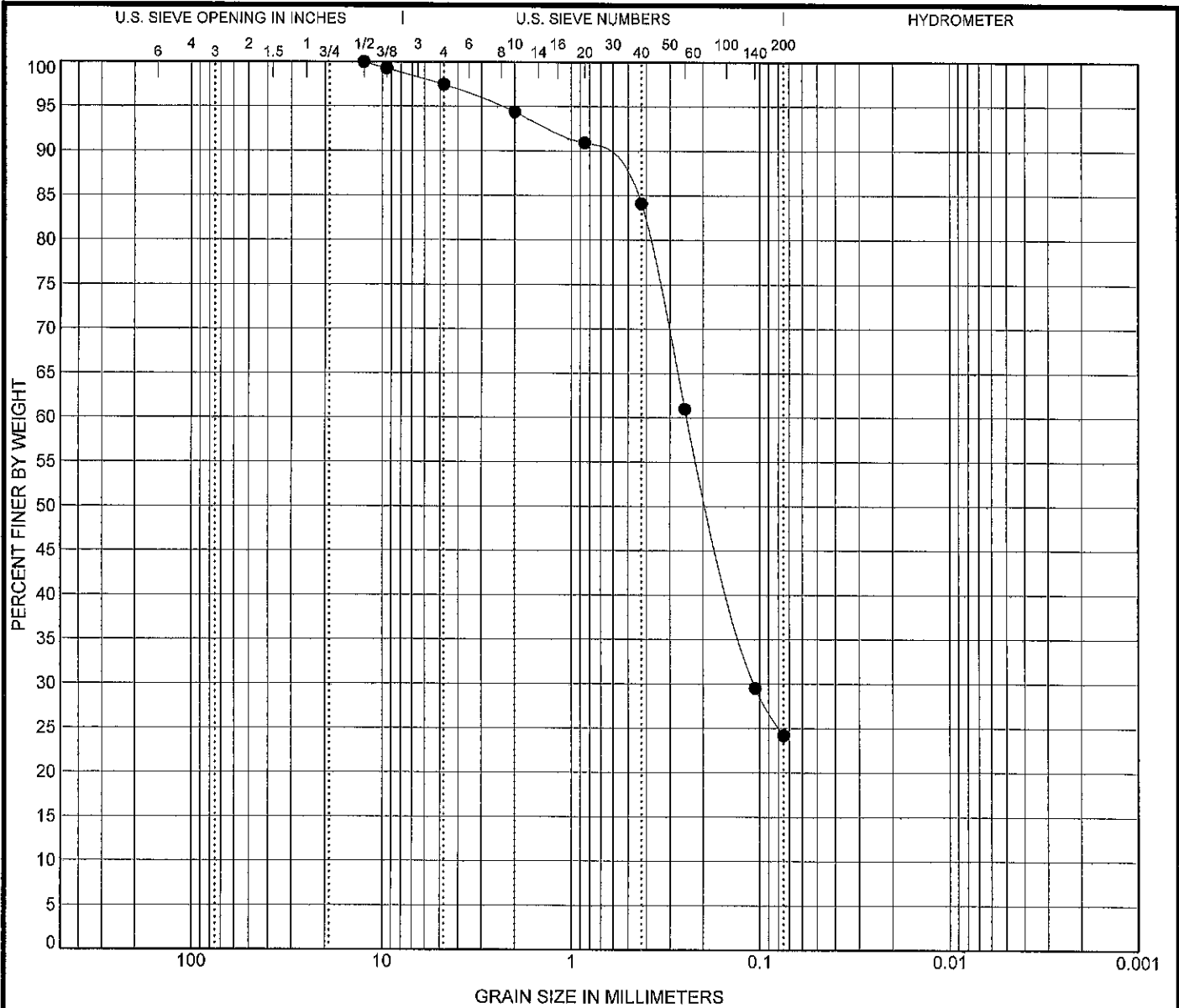
PROJECT NUMBER: N1135044

CLIENT: John Poe Architects

EXHIBIT B-3

# GRAIN SIZE DISTRIBUTION

ASTM D422



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID		Depth	USCS Classification				LL	PL	PI	Cc	Cu
●	SPD-6	48.5	BROWN SILTY CLAYEY SAND								
Boring ID		Depth	D <sub>100</sub>	D <sub>60</sub>	D <sub>30</sub>	D <sub>10</sub>	%Gravel	%Sand	%Silt	%Clay	
●	SPD-6	48.5	12.5	0.243	0.107		2.5	73.3	24.2		

PROJECT: VAMC SPD Addition

SITE: 17273 State Route 104  
Chillicothe, Ohio

**Terracon**

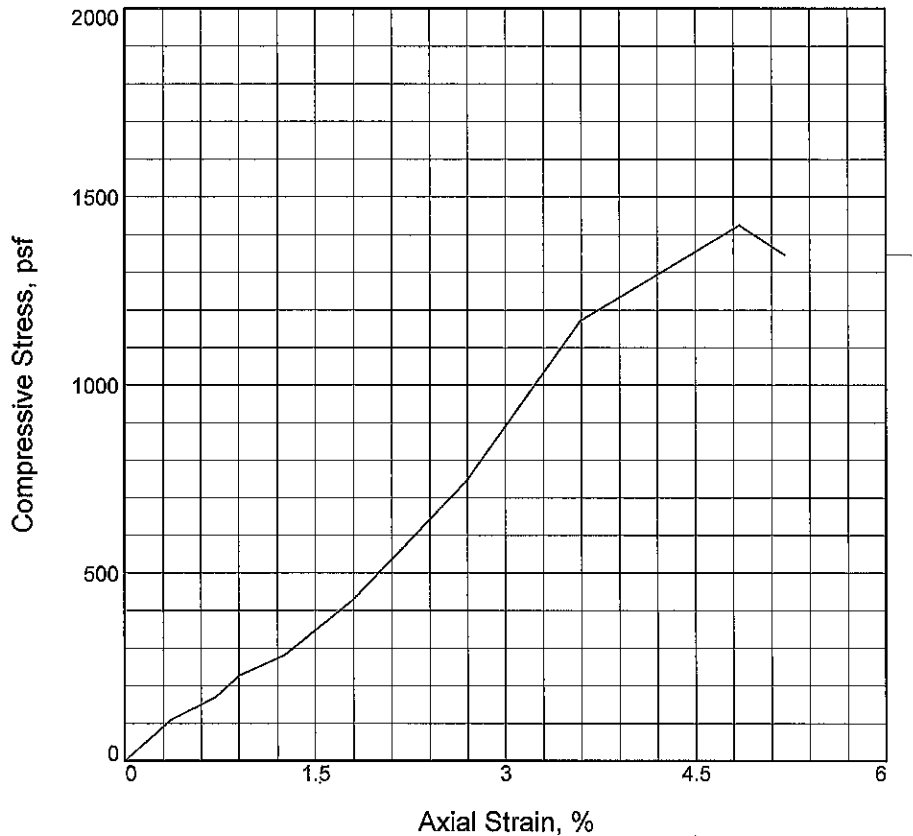
611 Lunken Park Drive  
Cincinnati, Ohio

PROJECT NUMBER: N1135044

CLIENT: John Poe Architects

EXHIBIT B-4

# UNCONFINED COMPRESSION TEST



Sample No.	1		
Unconfined strength, psf	1424.0		
Undrained shear strength, psf	712.0		
Failure strain, %	4.8		
Strain rate, in./min.	0.055		
Water content, %	21.7		
Wet density, pcf	125.0		
Dry density, pcf	102.8		
Saturation, %	91.4		
Void ratio	0.6404		
Specimen diameter, in.	2.850		
Specimen height, in.	5.570		
Height/diameter ratio	1.95		

**Description:** BROWN LEAN CLAY

**LL** = 29

**PL** = 16

**PI** = 13

**GS** = 2.70

**Type:** ST

**Project No.:** N1135044

**Date Sampled:** 4-9-13

**Remarks:**

Lab No. 2027

**Client:** JOHN POE ARCHITECTS

**Project:** VAMC SPD BUILDING

**Source of Sample:** SPD-1

**Depth:** 3-5'

**Sample Number:** ST-2

UNCONFINED COMPRESSION TEST

**Terracon, Inc.**

Cincinnati, Ohio

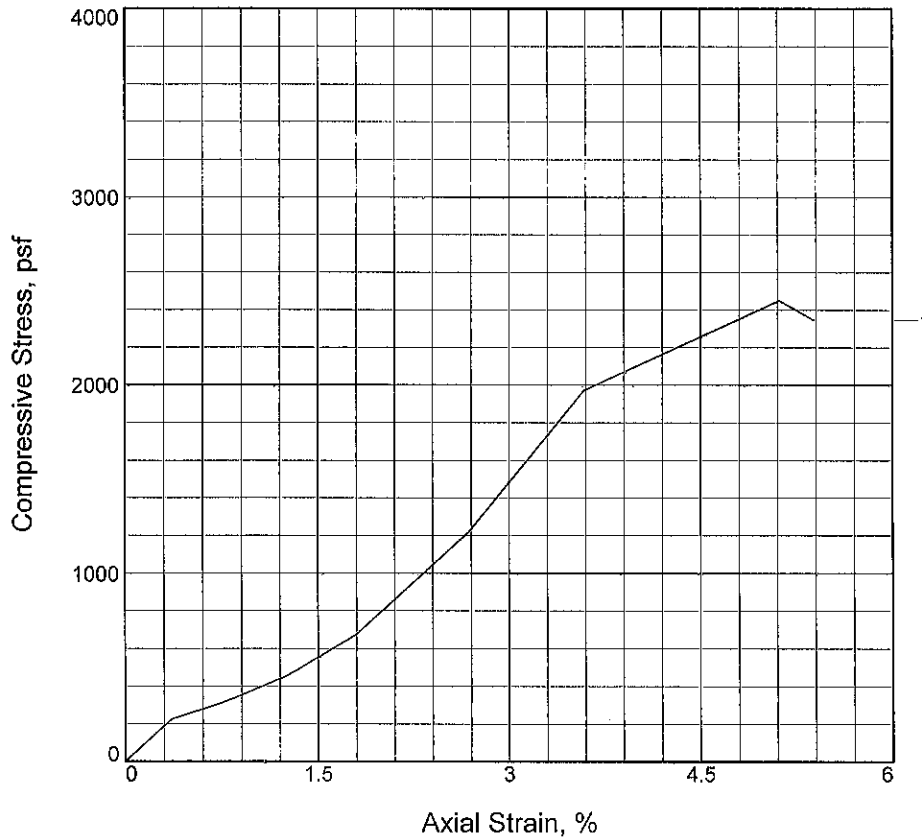
Figure \_\_\_\_\_

Tested By: SV

Checked By: GS

EXHIBIT B-5

# UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	2450.2			
Undrained shear strength, psf	1225.1			
Failure strain, %	5.1			
Strain rate, in./min.	0.055			
Water content, %	17.8			
Wet density, pcf	128.0			
Dry density, pcf	108.7			
Saturation, %	87.3			
Void ratio	0.5511			
Specimen diameter, in.	2.840			
Specimen height, in.	5.570			
Height/diameter ratio	1.96			

**Description:** BROWN LEAN CLAY, MOIST - STIFF

LL = 33	PL = 16	PI = 17	Assumed GS= 2.70	Type: ST
---------	---------	---------	------------------	----------

**Project No.:** N1135044

**Date Sampled:** 4-3-13

**Remarks:**

Lab No. 2160

**Client:** JOHN POE ARCHITECT

**Project:** VAMC SPD ADDITION

**Source of Sample:** SPD-2      **Depth:** 4-6'

**Sample Number:** ST-2

UNCONFINED COMPRESSION TEST

**Terracon, Inc.**  
Cincinnati, Ohio

**Exhibit** \_\_\_\_\_

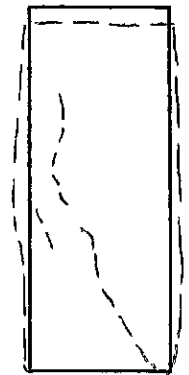
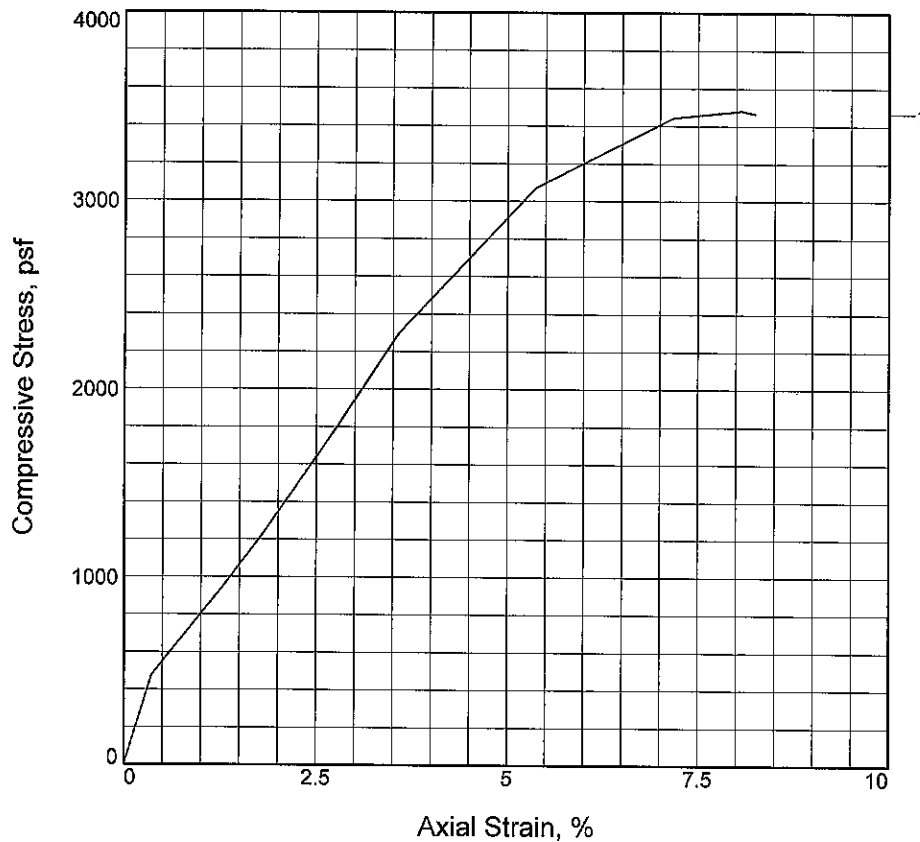
Tested By: SV

Checked By: GS

EXHIBIT B-6



# UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	3481.1			
Undrained shear strength, psf	1740.6			
Failure strain, %	8.1			
Strain rate, in./min.	0.055			
Water content, %	19.8			
Wet density, pcf	131.2			
Dry density, pcf	109.5			
Saturation, %	99.2			
Void ratio	0.5398			
Specimen diameter, in.	2.830			
Specimen height, in.	5.580			
Height/diameter ratio	1.97			

**Description:** BROWN LEAN CLAY W/SHALE AND CONCRETIONS, MOIST - STIFF

LL =      PL =      PI =      Assumed GS= 2.70      Type: ST

**Project No.:** N1135044

**Date Sampled:** 4-3-13

**Remarks:**

Lab No. 2070

**Client:** JOHN POE ARCHITECT

**Project:** VAMC SPD ADDITION

**Source of Sample:** SPD-4      **Depth:** 3-5'

**Sample Number:** ST-2

UNCONFINED COMPRESSION TEST

**Terracon, Inc.**

Cincinnati, Ohio

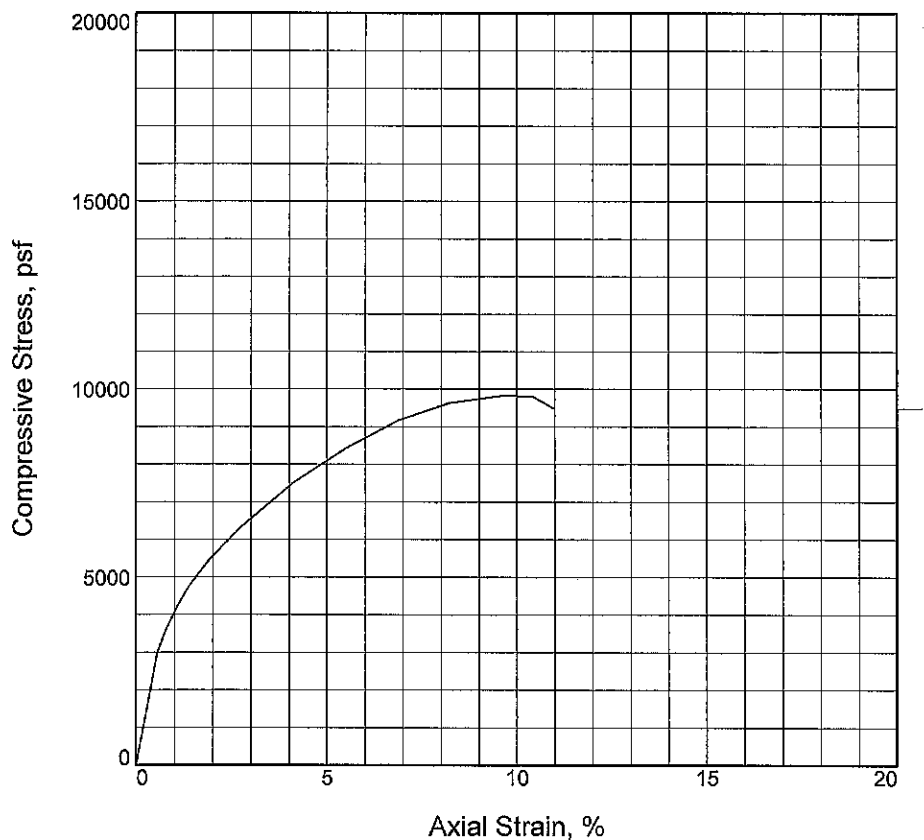
**Figure** \_\_\_\_\_

**Tested By:** SV

**Checked By:** GS

EXHIBIT B-7

# UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	9819.1			
Undrained shear strength, psf	4909.5			
Failure strain, %	9.6			
Strain rate, in./min.	0.036			
Water content, %	12.3			
Wet density, pcf	107.7			
Dry density, pcf	95.9			
Saturation, %	43.8			
Void ratio	0.7583			
Specimen diameter, in.	1.400			
Specimen height, in.	3.650			
Height/diameter ratio	2.61			

**Description:** DARK BROWN SANDY LEAN CLAY W/GRAVEL, MOIST - HARD

**LL =**      **PL =**      **PI =**      **Assumed GS= 2.70**      **Type: SS**

**Project No.:** N1135044

**Date Sampled:** 4-11-13

**Remarks:**

Lab No. 2463

**Client:** JOHN POE ARCHITECT

**Project:** VAMC SPD ADDITION

**Source of Sample:** SPD-4

**Depth:** 38.5-40'

**Sample Number:** 11

UNCONFINED COMPRESSION TEST

**Terracon, Inc.**

Cincinnati, Ohio

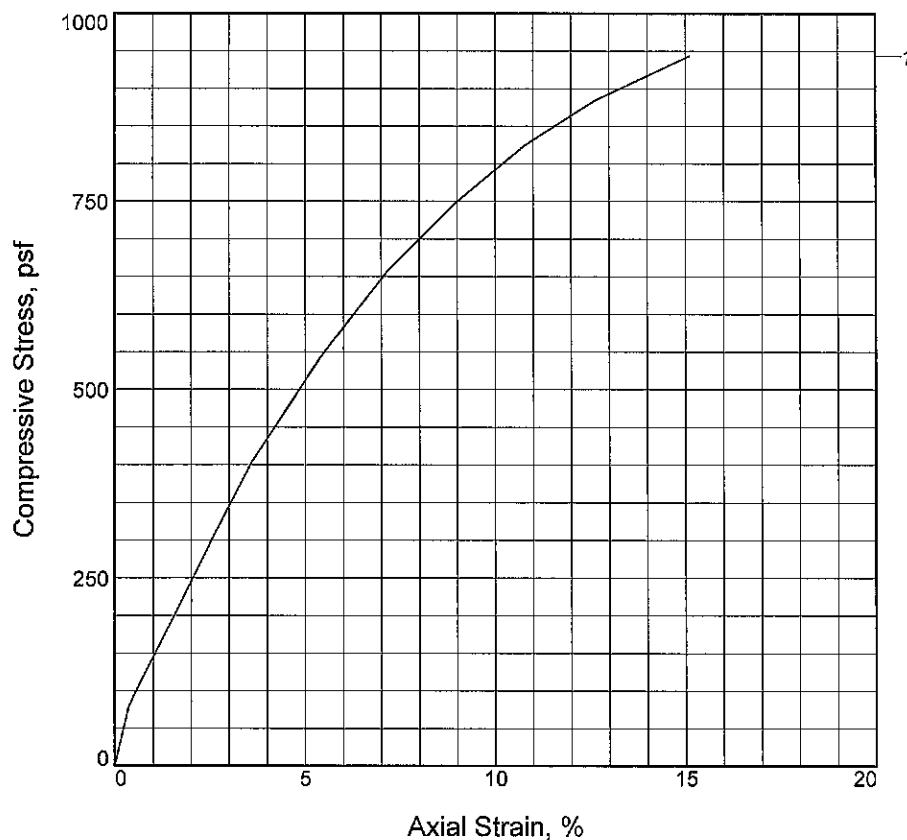
**Exhibit** \_\_\_\_\_

**Tested By:** SV

**Checked By:** GS

EXHIBIT B-8

# UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	943.4			
Undrained shear strength, psf	471.7			
Failure strain, %	15.1			
Strain rate, in./min.	0.055			
Water content, %	19.7			
Wet density, pcf	133.7			
Dry density, pcf	111.7			
Saturation, %	104.6			
Void ratio	0.5092			
Specimen diameter, in.	2.820			
Specimen height, in.	5.560			
Height/diameter ratio	1.97			

**Description:** BROWN SANDY LEAN CLAY W/GRAVEL, MOIST - SOFT

**LL =** **PL =** **PI =** **Assumed GS= 2.70** **Type: ST**

**Project No.:** N1135044

**Date Sampled:** 4-5-13

**Remarks:**  
Lab No. 2144

**Client:** JOHN POE ARCHITECT

**Project:** VAMC SPD ADDITION

**Source of Sample:** SPD-6 **Depth:** 10-12'

**Sample Number:** ST-5

UNCONFINED COMPRESSION TEST

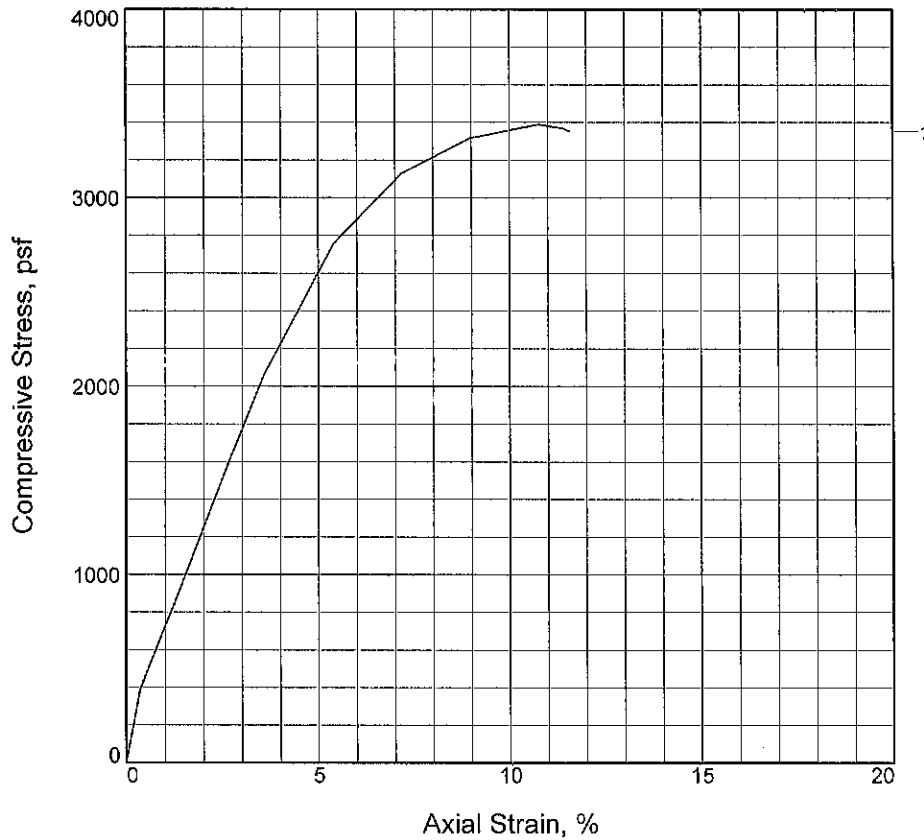
**Terracon, Inc.**  
Cincinnati, Ohio

**Figure** \_\_\_\_\_

**Tested By:** SV **Checked By:** GS

EXHIBIT B-9

# UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	3388.8			
Undrained shear strength, psf	1694.4			
Failure strain, %	10.8			
Strain rate, in./min.	0.055			
Water content, %	18.2			
Wet density, pcf	138.5			
Dry density, pcf	117.1			
Saturation, %	112.0			
Void ratio	0.4390			
Specimen diameter, in.	2.830			
Specimen height, in.	5.570			
Height/diameter ratio	1.97			

**Description:** BROWN SANDY LEAN CLAY, MOIST - STIFF

LL = 31

PL = 15

PI = 16

Assumed GS= 2.70

Type: ST

**Project No.:** N1135044

**Date Sampled:** 4-8-13

**Remarks:**

Lab No. 2145

**Client:** JOHN POE ARCHITECT

**Project:** VAMC SPD ADDITION

**Source of Sample:** SPD-6

**Depth:** 15-17'

**Sample Number:** ST-7

UNCONFINED COMPRESSION TEST

**Terracon, Inc.**  
Cincinnati, Ohio

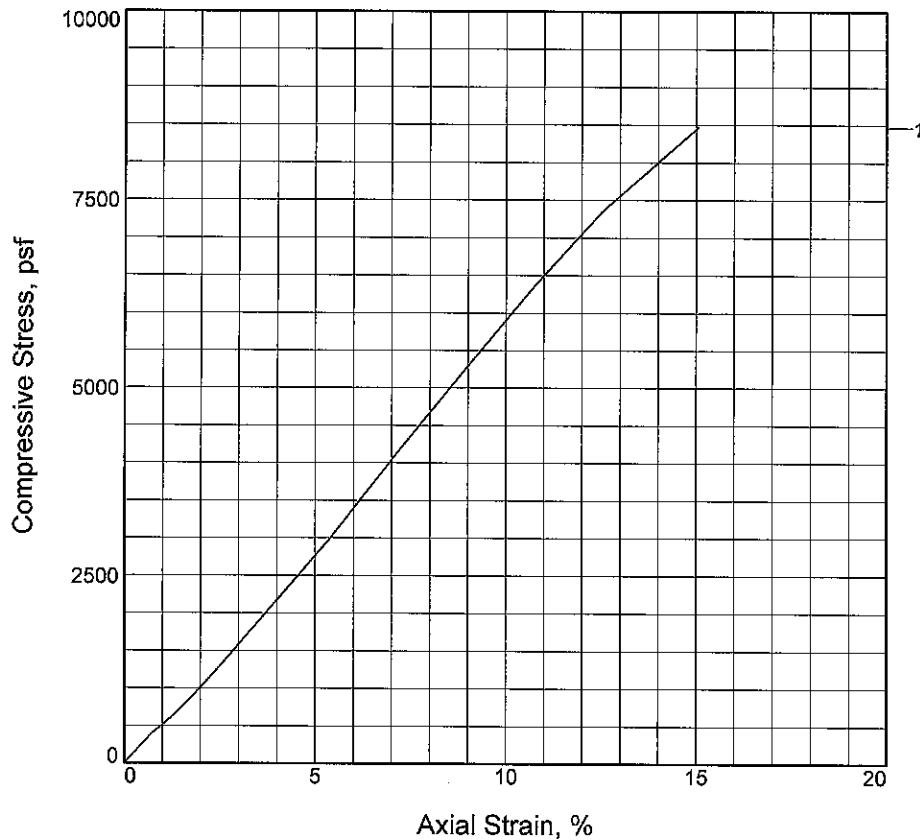
**Exhibit** \_\_\_\_\_

Tested By: SV

Checked By: GS

EXHIBIT B-10

# UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	8465.5			
Undrained shear strength, psf	4232.7			
Failure strain, %	15.1			
Strain rate, in./min.	0.027			
Water content, %	13.7			
Wet density, pcf	144.3			
Dry density, pcf	126.9			
Saturation, %	112.5			
Void ratio	0.3283			
Specimen diameter, in.	1.420			
Specimen height, in.	2.790			
Height/diameter ratio	1.96			

**Description:** BROWN SANDY LEAN CLAY W/GRAVEL, MOIST - VERY STIFF

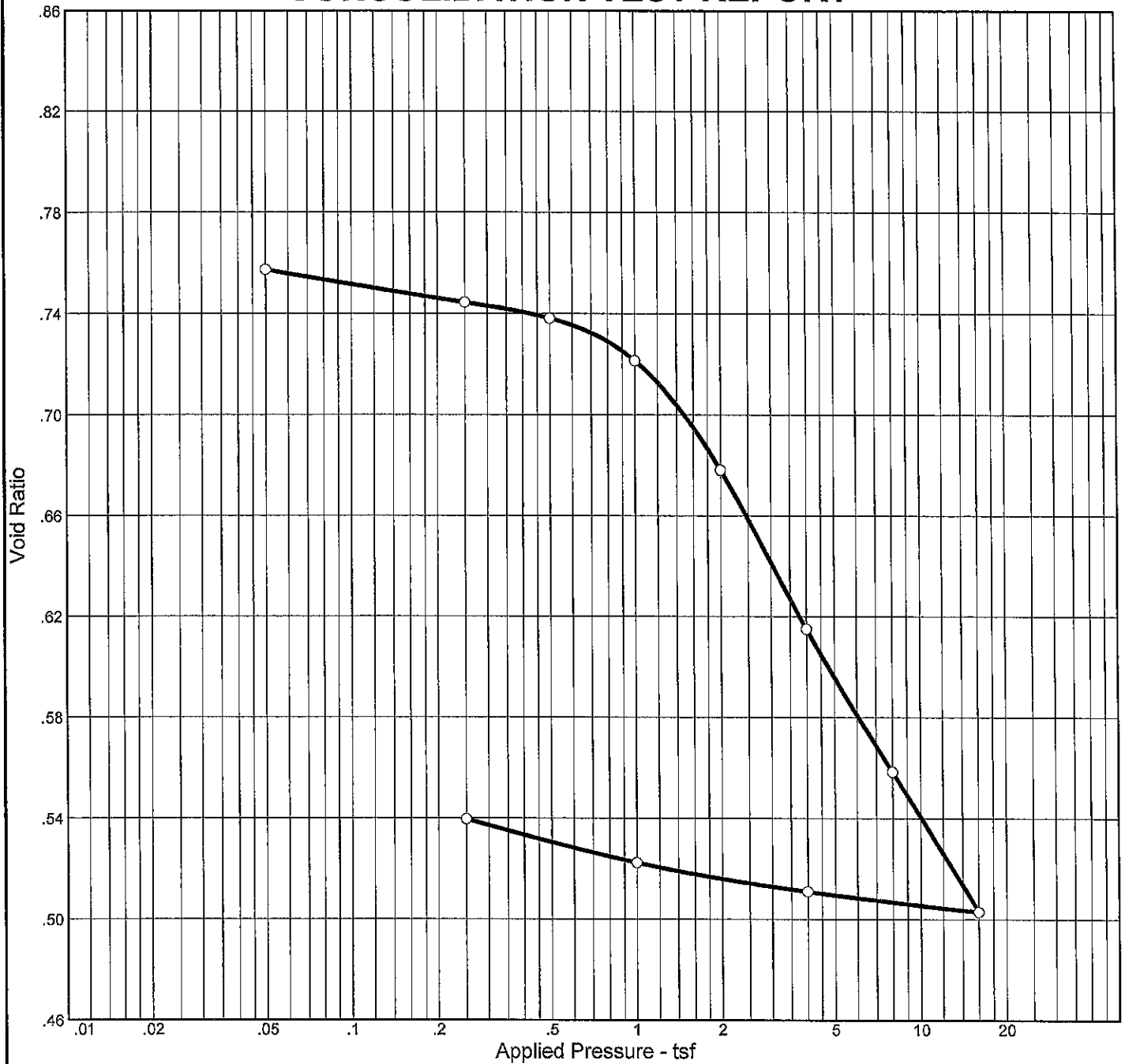
<b>LL =</b>	<b>PL =</b>	<b>PI =</b>	<b>Assumed GS= 2.70</b>	<b>Type: SS</b>
<b>Project No.:</b> N1135044 <b>Date Sampled:</b> 4-5-13 <b>Remarks:</b> Lab No. 2154			<b>Client:</b> JOHN POE ARCHITECT  <b>Project:</b> VAMC SPD ADDITION  <b>Source of Sample:</b> SPD-7 <b>Depth:</b> 18.5-20' <b>Sample Number:</b> 7	
<b>Figure</b> _____			UNCONFINED COMPRESSION TEST <b>Terracon, Inc.</b> Cincinnati, Ohio	

Tested By: SV

Checked By: GS

EXHIBIT B-11

# CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	$P_c$ (tsf)	$C_c$	$C_r$	Swell Press. (tsf)	Swell %	$e_o$
Sat.	Moist.											
78.4 %	21.7 %	97.3	29	13	2.739		1.07	0.18	0.02			0.758

MATERIAL DESCRIPTION										USCS	AASHTO
BROWN LEAN CLAY										CL	

<b>Project No.</b> N1135044			<b>Client:</b> JOHN POE ARCHITECTS			<b>Remarks:</b>  Lab No. 2027  <
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# Dial Reading vs. Time

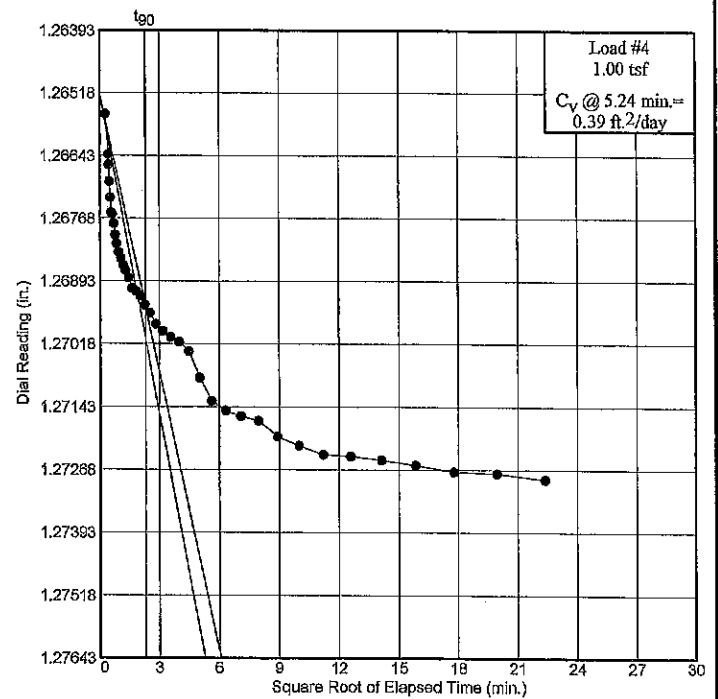
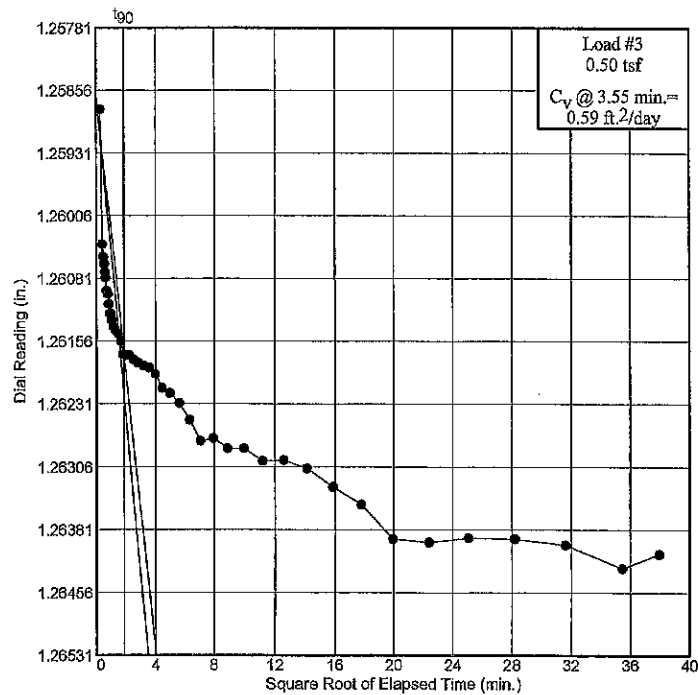
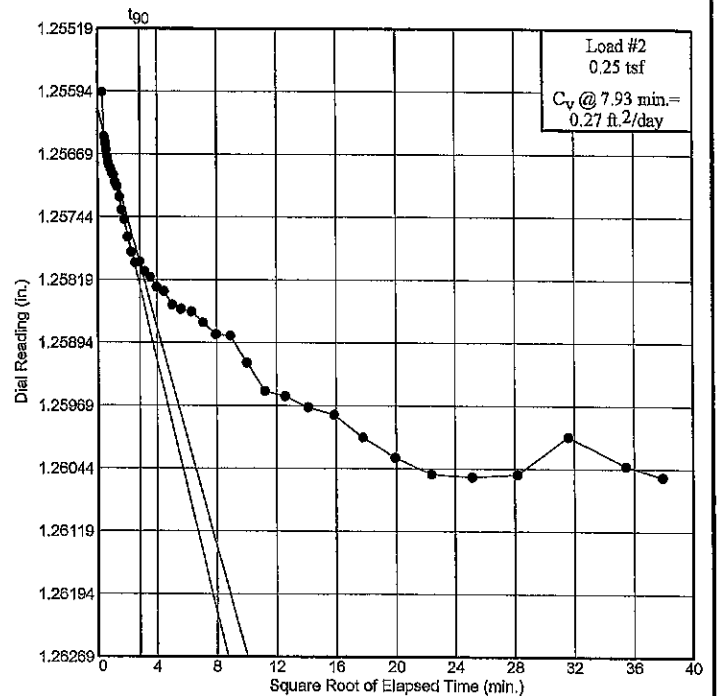
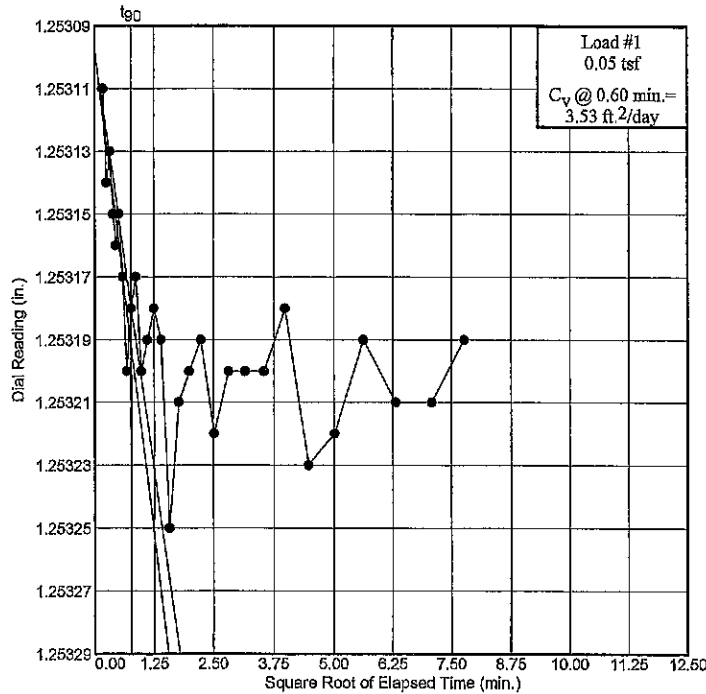
Project No.: N1135044

Project: VAMC SPD BUILDING

Source: SPD-1

Sample No.: ST-2

Elev./Depth: 3-5'



Terracon, Inc.  
Cincinnati, Ohio

EXHIBIT B-13

# Dial Reading vs. Time

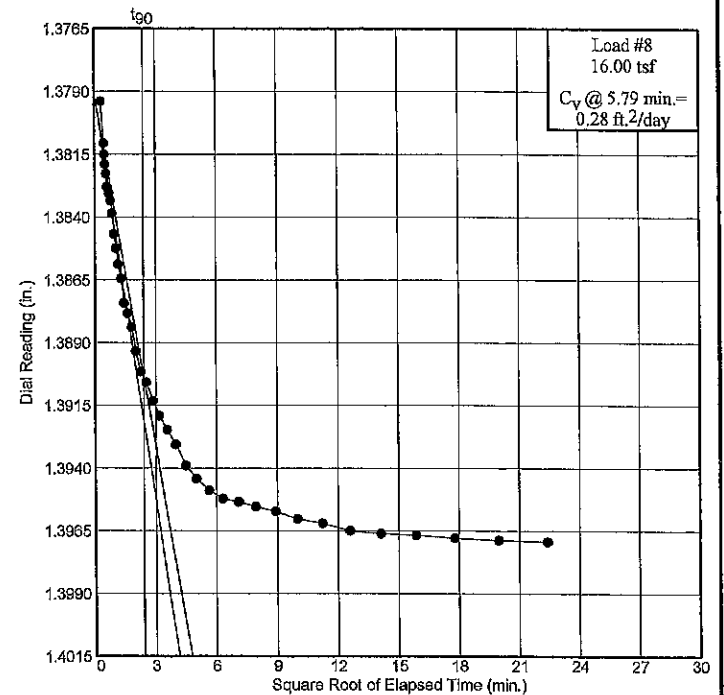
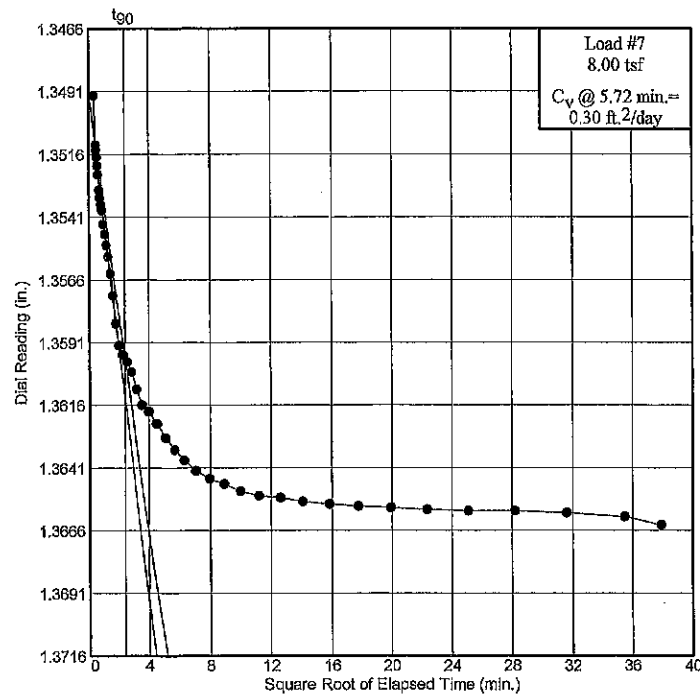
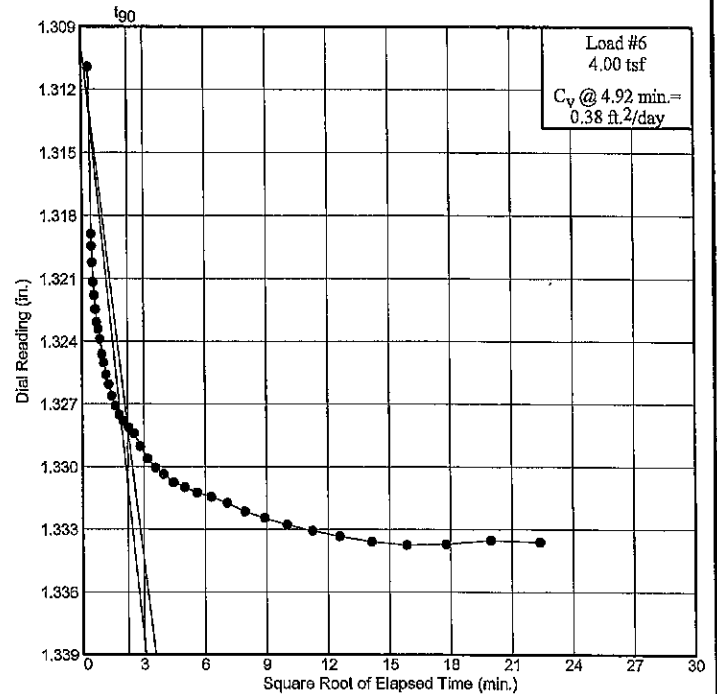
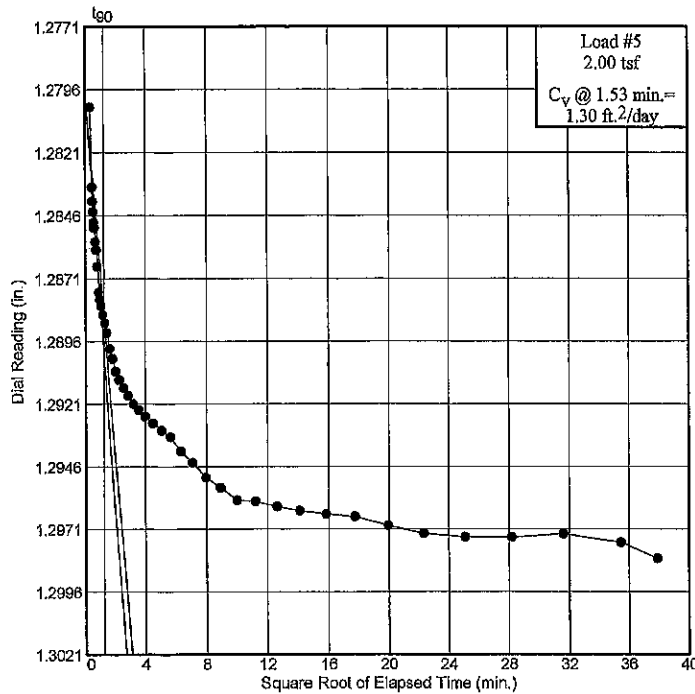
Project No.: N1135044

Project: VAMC SPD BUILDING

Source: SPD-1

Sample No.: ST-2

Elev./Depth: 3-5'



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EXHIBIT B-14



# Dial Reading vs. Time

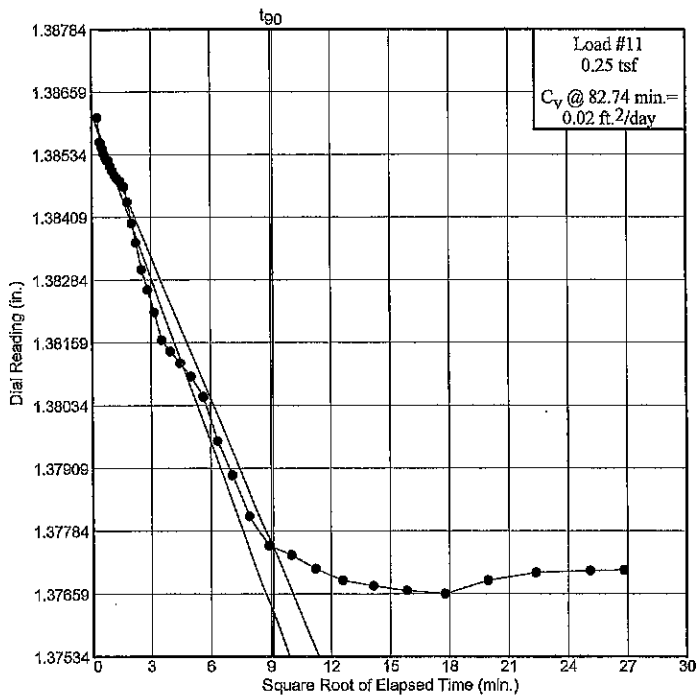
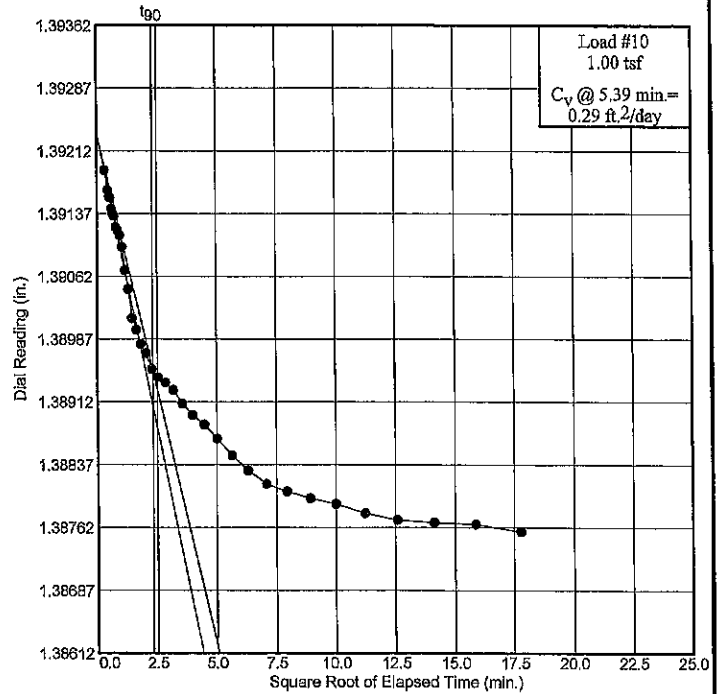
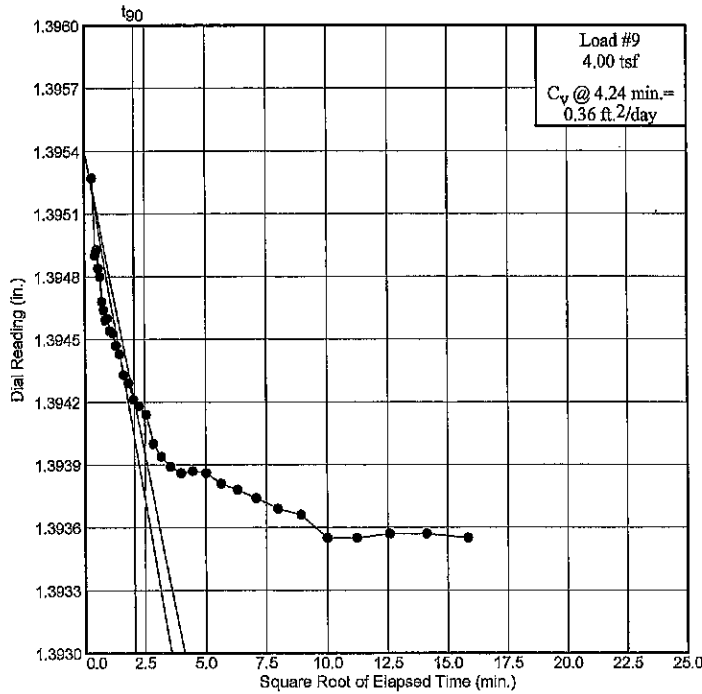
Project No.: N1135044

Project: VAMC SPD BUILDING

Source: SPD-1

Sample No.: ST-2

Elev./Depth: 3-5'



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Cincinnati, Ohio

EXHIBIT B-15

**APPENDIX C**  
**SUPPORTING DOCUMENTS**

## GENERAL NOTES

### DRILLING & SAMPLING SYMBOLS:

SS:	Split Spoon - 1- <sup>3</sup> / <sub>8</sub> " I.D., 2" O.D., unless otherwise noted	HS:	Hollow Stem Auger
ST:	Thin-Walled Tube – 2" O.D., 3" O.D., unless otherwise noted	PA:	Power Auger (Solid Stem)
RS:	Ring Sampler - 2.42" I.D., 3" O.D., unless otherwise noted	HA:	Hand Auger
DB:	Diamond Bit Coring - 4", N, B	RB:	Rock Bit
BS:	Bulk Sample or Auger Sample	WB:	Wash Boring or Mud Rotary

The number of blows required to advance a standard 2-inch O.D. split-spoon sampler (SS) the last 12 inches of the total 18-inch penetration with a 140-pound hammer falling 30 inches is considered the "Standard Penetration" or "N-value".

### WATER LEVEL MEASUREMENT SYMBOLS:

WL:	Water Level	WS:	While Sampling	BCR:	Before Casing Removal
WCI:	Wet Cave in	WD:	While Drilling	ACR:	After Casing Removal
DCI:	Dry Cave in	AB:	After Boring	N/E:	Not Encountered

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. Groundwater levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels may not be possible with only short-term observations.

**DESCRIPTIVE SOIL CLASSIFICATION:** Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

#### CONSISTENCY OF FINE-GRAINED SOILS

<u>Unconfined</u> <u>Compressive</u> <u>Strength, Qu, psf</u>	<u>Standard Penetration</u> <u>or N-value (SS)</u> <u>Blows/Ft.</u>	<u>Consistency</u>
< 500	0 - 1	Very Soft
500 – 1,000	2 - 4	Soft
1,000 – 2,000	4 - 8	Medium Stiff
2,000 – 4,000	8 - 15	Stiff
4,000 – 8,000	15 - 30	Very Stiff
8,000+	> 30	Hard

#### RELATIVE DENSITY OF COARSE-GRAINED SOILS

<u>Standard Penetration</u> <u>or N-value (SS)</u> <u>Blows/Ft.</u>	<u>Relative Density</u>
0 – 3	Very Loose
4 – 9	Loose
10 – 29	Medium Dense
30 – 50	Dense
> 50	Very Dense

#### RELATIVE PROPORTIONS OF SAND AND GRAVEL

<u>Descriptive Term(s)</u> <u>of other constituents</u>	<u>Percent of</u> <u>Dry Weight</u>
Trace	< 15
With	15 – 29
Modifier	≥ 30

#### GRAIN SIZE TERMINOLOGY

<u>Major Component</u> <u>of Sample</u>	<u>Particle Size</u>
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75mm)
Sand	#4 to #200 sieve (4.75 to 0.075mm)
Silt or Clay	Passing #200 Sieve (0.075mm)

#### RELATIVE PROPORTIONS OF FINES

<u>Descriptive Term(s)</u> <u>of other constituents</u>	<u>Percent of</u> <u>Dry Weight</u>
Trace	< 5
With	5 – 12
Modifier	> 12

#### PLASTICITY DESCRIPTION

<u>Term</u>	<u>Plasticity</u> <u>Index</u>
Non-plastic	0
Low	1-10
Medium	11-30
High	> 30

# UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests <sup>A</sup>					Soil Classification	
					Group Symbol	Group Name <sup>B</sup>
Coarse Grained Soils: More than 50% retained on No. 200 sieve	Gravels: More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels: Less than 5% fines <sup>C</sup>	Cu ≥ 4 and 1 ≤ Cc ≤ 3 <sup>E</sup>		GW	Well-graded gravel <sup>F</sup>
			Cu < 4 and/or 1 > Cc > 3 <sup>E</sup>		GP	Poorly graded gravel <sup>F</sup>
		Gravels with Fines: More than 12% fines <sup>C</sup>	Fines classify as ML or MH		GM	Silty gravel <sup>F,G, H</sup>
			Fines classify as CL or CH		GC	Clayey gravel <sup>F,G,H</sup>
	Sands: 50% or more of coarse fraction passes No. 4 sieve	Clean Sands: Less than 5% fines <sup>D</sup>	Cu ≥ 6 and 1 ≤ Cc ≤ 3 <sup>E</sup>		SW	Well-graded sand <sup>I</sup>
			Cu < 6 and/or 1 > Cc > 3 <sup>E</sup>		SP	Poorly graded sand <sup>I</sup>
		Sands with Fines: More than 12% fines <sup>D</sup>	Fines classify as ML or MH		SM	Silty sand <sup>G,H,I</sup>
			Fines Classify as CL or CH		SC	Clayey sand <sup>G,H,I</sup>
Fine-Grained Soils: 50% or more passes the No. 200 sieve	Silts and Clays: Liquid limit less than 50	Inorganic:	PI > 7 and plots on or above “A” line <sup>J</sup>		CL	Lean clay <sup>K,L,M</sup>
			PI < 4 or plots below “A” line <sup>J</sup>		ML	Silt <sup>K,L,M</sup>
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay <sup>K,L,M,N</sup>
			Liquid limit - not dried			Organic silt <sup>K,L,M,O</sup>
	Silts and Clays: Liquid limit 50 or more	Inorganic:	PI plots on or above “A” line		CH	Fat clay <sup>K,L,M</sup>
			PI plots below “A” line		MH	Elastic Silt <sup>K,L,M</sup>
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay <sup>K,L,M,P</sup>
			Liquid limit - not dried			Organic silt <sup>K,L,M,Q</sup>
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

<sup>A</sup> Based on the material passing the 3-in. (75-mm) sieve

<sup>B</sup> If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

<sup>C</sup> Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

<sup>D</sup> Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

$$^E Cu = D_{60}/D_{10} \quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

<sup>F</sup> If soil contains  $\geq 15\%$  sand, add "with sand" to group name.

<sup>G</sup> If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

<sup>H</sup> If fines are organic, add "with organic fines" to group name.

<sup>I</sup> If soil contains  $\geq 15\%$  gravel, add "with gravel" to group name.

<sup>J</sup> If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

<sup>K</sup> If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

<sup>L</sup> If soil contains  $\geq 30\%$  plus No. 200 predominantly sand, add "sandy" to group name.

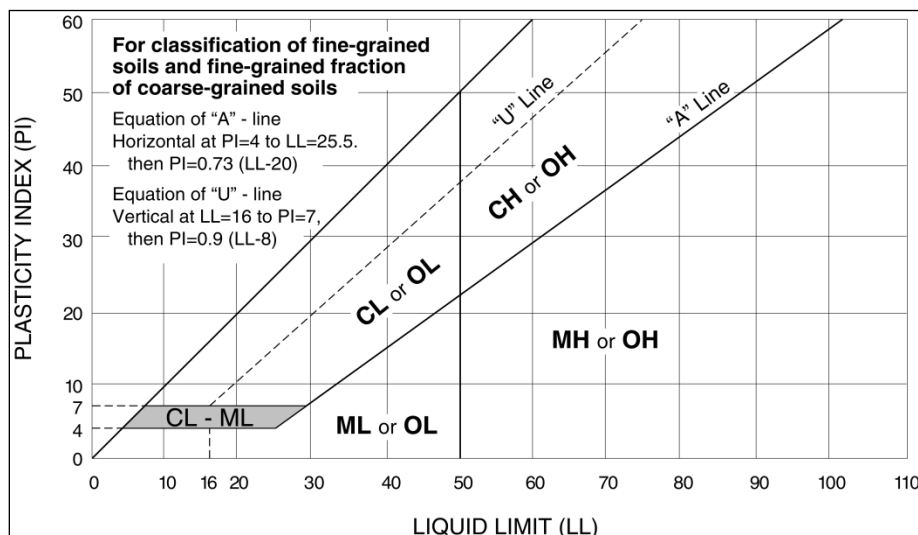
<sup>M</sup> If soil contains  $\geq 30\%$  plus No. 200, predominantly gravel, add "gravelly" to group name.

<sup>N</sup>  $PI \geq 4$  and plots on or above "A" line.

<sup>O</sup>  $PI < 4$  or plots below "A" line.

<sup>P</sup> PI plots on or above "A" line.

<sup>Q</sup> PI plots below "A" line.



**SECTION 03 30 00**  
**CAST-IN-PLACE CONCRETE**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

This section specifies cast-in-place structural concrete and materials and mixes for other concrete.

**1.2 RELATED WORK:**

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.

**1.3 TESTING AGENCY FOR CONCRETE MIX DESIGN:**

- A. Testing agency maintaining active participation in Program of Cement and Concrete Reference Laboratory (CCRL) of National Institute of Standards and Technology. B. Testing agency shall furnish equipment and qualified technicians to establish proportions of ingredients for concrete mixes.

**1.4 TOLERANCES:**

- A. Formwork: ACI 117, except the elevation tolerance of formed surfaces before removal of shores is +0 inch and -3/4 inch.
- B. Reinforcement Fabricating and Placing: ACI 117, except that fabrication tolerance for bar sizes Nos. 3, 4, and 5 (Tolerance Symbol 1 in Fig. 2.1(a), ACI, 117) used as column ties or stirrups is +0 inch and -1/2 inch where gross bar length is less than 12 feet, or +0 inch and -3/4 inch where gross bar length is 12 feet or more.
- C. Cross-Sectional Dimension: ACI 117, except tolerance for thickness of slabs 12 inches or less is +3/4 inch and -1/4 inch. Tolerance of thickness of beams more than 12 inch but less than 3 feet is +3/4 inch and -3/8 inch.
- D. Slab Finishes: ACI 117, Section 4.5.6, F-number method in accordance with ASTM E1155, except as follows:
  - 1. Test entire slab surface, including those areas within 2 feet of construction joints and vertical elements that project through slab surface.
  - 2. Maximum elevation change which may occur within 2 feet of any column or wall element is 0.25 inches.
  - 3. Allow sample measurement lines that are perpendicular to construction joints to extend past joint into previous placement no further than 5 feet.

**1.5 REGULATORY REQUIREMENTS:**

- A. ACI SP-66 – ACI Detailing Manual.
- B. ACI 318 - Building Code Requirements for Reinforced Concrete.
- C. ACI 301 – Standard Specifications for Structural Concrete.

**1.6 SUBMITTALS:**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Shop Drawings: Reinforcing steel: Complete shop drawings
- C. Mill Test Reports:
  - 1. Reinforcing Steel.
  - 2. Cement.
- D. Manufacturer's Certificates:
  - 1. Abrasive aggregate.
  - 2. Air-entraining admixture.
  - 3. Chemical admixtures, including chloride ion content.
  - 4. Liquid membrane-forming compounds for curing concrete.
  - 5. Non-shrinking grout.
  - 6. Liquid hardener.
  - 11. Adhesive binder.
- E. Testing Agency for Concrete Mix Design: Approval request including qualifications of principals and technicians and evidence of active participation in program of Cement and Concrete Reference Laboratory (CCRL) of National Institute of Standards and Technology
- F. Test Report for Concrete Mix Designs: Trial mixes including water-cement, fly ash ratio curves, concrete mix ingredients, and admixtures

**1.7 DELIVERY, STORAGE, AND HANDLING:**

- A. Conform to ACI 304. Store aggregate separately for each kind or grade, to prevent segregation of sizes and avoid inclusion of dirt and other materials.
- B. Deliver cement in original sealed containers bearing name of brand and manufacturer, and marked with net weight of contents. Store in suitable watertight building in which floor is raised at least 1 foot above ground. Store bulk cement and fly ash in separate suitable bins.
- C. Deliver other packaged materials for use in concrete in original sealed containers, plainly marked with manufacturer's name and brand, and protect from damage until used.

**1.8 PRE-CONCRETE CONFERENCE:**

- A. General: At least 15 days prior to submittal of design mixes, conduct a meeting to review proposed methods of concrete construction to achieve the required results.
- B. Agenda: Includes but is not limited to:
  - 1. Submittals.
  - 2. Coordination of work.
  - 3. Availability of material.
  - 4. Concrete mix design including admixtures.
  - 5. Methods of placing, finishing, and curing.

6. Finish criteria required to obtain required flatness and levelness.
  7. Timing of floor finish measurements.
  8. Material inspection and testing.
- C. Attendees: Include but not limited to representatives of Contractor; subcontractors involved in supplying, conveying, placing, finishing, and curing concrete; admixture manufacturers; COR; Consulting Engineer; D. Minutes of the meeting: Contractor shall take minutes and type and distribute the minutes to attendees within five days of the meeting.

#### 1.9 APPLICABLE PUBLICATIONS:

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Concrete Institute (ACI):
- 117-10 ..... Specifications for Tolerances for Concrete Construction and Materials and Commentary
  - 211.1-91(R2009) ..... Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
  - 214R-11 ..... Guide to Evaluation of Strength Test Results of Concrete
  - 301-10 ..... Standard Practice for Structural Concrete
  - 304R-00(R2009) ..... Guide for Measuring, Mixing, Transporting, and Placing Concrete
  - 305.1-06 ..... Specification for Hot Weather Concreting
  - 306.1-90(R2002) ..... Standard Specification for Cold Weather Concreting
  - 308.1-11 ..... Specification for Curing Concrete
  - 309R-05 ..... Guide for Consolidation of Concrete
  - 318-11 ..... Building Code Requirements for Structural Concrete and Commentary
  - 347-04 ..... Guide to Formwork for Concrete
  - SP-66-04 ..... ACI Detailing Manual
- C. American National Standards Institute and American Hardboard Association (ANSI/AHA):
- A135.4-2004 ..... Basic Hardboard
- D. American Society for Testing and Materials (ASTM):
- A82/A82M-07 ..... Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
  - A185/185M-07 ..... Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
  - A615/A615M-09 ..... Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement
  - A706/A706M-09 ..... Standard Specification for Low Alloy Steel Deformed and Plain Bars for Concrete Reinforcement

A775/A775M-07 .....	Standard Specification for Epoxy Coated Reinforcing Steel Bars
A996/A996M-09 .....	Standard Specification for Rail Steel and Axle Steel Deformed Bars for Concrete Reinforcement
C31/C31M-10.....	Standard Practice for Making and Curing Concrete Test Specimens in the field
C33/C33M-11A .....	Standard Specification for Concrete Aggregates
C39/C39M-12.....	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
C94/C94M-12.....	Standard Specification for Ready Mixed Concrete
C143/C143M-10.....	Standard Test Method for Slump of Hydraulic Cement Concrete
C150-11 .....	Standard Specification for Portland Cement
C171-07 .....	Standard Specification for Sheet Materials for Curing Concrete
C172-10 .....	Standard Practice for Sampling Freshly Mixed Concrete
C173-10... .....	Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
C192/C192M-07.....	Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
C231-10 .....	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
C260-10 .....	Standard Specification for Air Entraining Admixtures for Concrete
C309-11 .....	Standard Specification for Liquid Membrane Forming Compounds for Curing Concrete
C494/C494M-11.....	Standard Specification for Chemical Admixtures for Concrete
C618-12 .....	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
C881/C881M-10.....	Standard Specification for Epoxy Resin Base Bonding Systems for Concrete
C1107/1107M-11 .....	Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)
C1315-11 .....	Standard Specification for Liquid Membrane Forming Compounds Having Special Properties for Curing and Sealing Concrete
D6-95(R2011) .....	Standard Test Method for Loss on Heating of Oil and Asphaltic Compounds
D297-93(R2006) .....	Standard Methods for Rubber Products Chemical Analysis
D412—06AE2 .....	Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension



- D1751-04(R2008) ..... Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
- D4263-83(2012) ..... Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
- D4397-10 ..... Standard Specification for Polyethylene Sheeting for Construction, Industrial and Agricultural Applications
- F1869-11 ..... Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
- E. American Welding Society (AWS):  
D1.4/D1.4M-11 ..... Structural Welding Code - Reinforcing Steel
- F. Concrete Reinforcing Steel Institute (CRSI):  
Handbook 2008
- G. National Cooperative Highway Research Program (NCHRP):  
Report On..... Concrete Sealers for the Protection of Bridge Structures
- H. U. S. Department of Commerce Product Standard (PS):  
PS 1..... Construction and Industrial Plywood  
PS 20..... American Softwood Lumber
- I. U. S. Army Corps of Engineers Handbook for Concrete and Cement:  
CRD C513..... Rubber Waterstops  
CRD C572..... Polyvinyl Chloride Waterstops

## **PART 2 – PRODUCTS:**

### **2.1 FORMS:**

- A. Wood: PS 20 free from loose knots and suitable to facilitate finishing concrete surface specified; tongue and grooved.
- B. Plywood: PS-1 Exterior Grade B-B (concrete-form) 5/8 inch, or 3/4 inch thick for unlined contact form. B-B High Density Concrete Form Overlay optional.
- C. Metal for Concrete Rib-Type Construction: Steel (removal type) of suitable weight and form to provide required rigidity.
- D. Permanent Steel Form for Concrete Slabs: Corrugated, ASTM A653, Grade E, and Galvanized, ASTM A653, G90. Provide venting where insulating concrete fill is used.
- E. Corrugated Fiberboard Void Boxes: Double faced, completely impregnated with paraffin and laminated with moisture resistant adhesive, size as shown. Design forms to support not less than 1000 psf and not lose more than 15 percent of their original strength after being completely submerged in water for 24 hours and then air dried.
- F. Form Lining:

1. Hardboard: ANSI/AHA A135.4, Class 2 with one (S1S) smooth side)
2. Plywood: Grade B-B Exterior (concrete-form) not less than 1/4 inch thick.
3. Plastic, fiberglass, or elastomeric capable of reproducing the desired pattern or texture.

G. Concrete products shall comply with following standards for biobased materials:

Material Type	Percent by Weight
Concrete Penetrating Liquid	79 percent biobased material
Concrete form Release Agent	87 percent biobased material
Concrete Sealer	11 percent biobased material

The minimum-content standards are based on the weight (not the volume) of the material.

- H. Form Ties: Develop a minimum working strength of 3000 pounds when fully assembled. Ties shall be adjustable in length to permit tightening of forms and not have any lugs, cones, washers to act as spreader within form, nor leave a hole larger than 3/4 inch diameter, or a depression in exposed concrete surface, or leave metal closer than 1 1/2 inches to concrete surface. Wire ties not permitted. Cutting ties back from concrete face not permitted.

## 2.2 MATERIALS:

- A. Portland Cement: ASTM C150 Type I or II.
- B. Fly Ash: ASTM C618, Class C or F including supplementary optional requirements relating to reactive aggregates and alkalies, and loss on ignition (LOI) not to exceed 5 percent.
- C. Coarse Aggregate: ASTM C33.
1. Size 67 or Size 467 may be used for footings and walls over 12 inches thick.
  2. Coarse aggregate for applied topping, encasement of steel columns, and metal pan stair fill shall be Size 7.
  3. Maximum size of coarse aggregates not more than one-fifth of narrowest dimension between sides of forms, one-third of depth of slabs, nor three-fourth of minimum clear spacing between reinforcing bars.
- D. Fine Aggregate: ASTM C33. Fine aggregate for applied concrete floor topping shall pass a No. 4 sieve, 10 percent maximum shall pass a No. 100 sieve.
- E. Mixing Water: Fresh, clean, and potable.
- F. Admixtures:
1. Water Reducing Admixture: ASTM C494, Type A and not contain more chloride ions than are present in municipal drinking water.
  2. Water Reducing, Retarding Admixture: ASTM C494, Type D and not contain more chloride ions than are present in municipal drinking water.
  3. High-Range Water-Reducing Admixture (Superplasticizer): ASTM C494, Type F or G, and not contain more chloride ions than are present in municipal drinking water.

4. Non-Corrosive, Non-Chloride Accelerator: ASTM C494, Type C or E, and not contain more chloride ions than are present in municipal drinking water. Admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory of at least one year duration using an acceptable accelerated corrosion test method such as that using electrical potential measures.
5. Air Entraining Admixture: ASTM C260.
6. Microsilica: Use only with prior review and acceptance of the COR. Use only in conjunction with high range water reducer.
7. Prohibited Admixtures: Calcium chloride, thiocyanate or admixtures containing more than 0.05 percent chloride ions are not permitted.
8. Certification: Written conformance to the requirements above and the chloride ion content of the admixture prior to mix design review.
- G. Vapor Barrier: ASTM D4397, 0.38 mm (15 mil).
- H. Reinforcing Steel: ASTM A615, or ASTM A996, deformed, grade as shown.
- I. Welded Wire Fabric: ASTM A185.
- J. Reinforcing Bars to be Welded: ASTM A706.
- .
- K. Epoxy Coated Reinforcing Bars: ASTM A775.
- L. Reinforcement for Metal Pan Stair Fill: 2 inch wire mesh, either hexagonal mesh at 1.5 pounds per square yard, or square mesh at 1.17 pounds per square yard.
- M. Supports, Spacers, and Chairs: Types which will hold reinforcement in position shown in accordance with requirements of ACI 318 except as specified.
- N. Expansion Joint Filler: ASTM D1751.
- O. Sheet Materials for Curing Concrete: ASTM C171.
- P. Liquid Membrane-forming Compounds for Curing Concrete: ASTM C309, Type I, with fugitive dye, and shall meet the requirements of ASTM C1315. Compound shall be compatible with scheduled surface treatment, such as paint and resilient tile, and shall not discolor concrete surface.
- Q. Abrasive Aggregate: Aluminum oxide grains or emery grits.
- R. Liquid Hardener and Dustproofers: Fluosilicate solution of magnesium fluosilicate or zinc fluosilicate. Magnesium and zinc may be used separately or in combination as recommended by manufacturer. Use only on exposed slab. Do not use where floor is covered with resilient flooring, paint or other finish coating.
- S. Moisture Vapor Emissions & Alkalinity Control Sealer: 100% active colorless aqueous silicate solution concrete surface.

1. ASTM C1315 Type 1 Class A, and ASTM C309 Type 1 Class A, penetrating product to have no less than 34% solid content, leaving no sheen, volatile organic compound (VOC) content rating as required to suite regulatory requirements. The product shall have at least a five (5) year documented history in controlling moisture vapor emission from damaging floor covering, compatible with all finish materials.
2. MVE 15-Year Warranty:
  - a. When a floor covering is installed on a below grade, on grade, or above grade concrete slab treated with Moisture Vapor Emissions & Alkalinity Control Sealer according to manufacturer's instruction, sealer manufacturer shall warrant the floor covering system against failure due to moisture vapor migration or moisture-born contaminants for a period of fifteen (15) years from the date of original installation. The warranty shall cover all labor and materials needed to replace all floor covering that fails due to moisture vapor emission & moisture born contaminants.

T. Non-Shrink Grout:

1. ASTM C1107, pre-mixed, produce a compressive strength of at least 18 MPa at three days and 5000 psi at 28 days. Furnish test data from an independent laboratory indicating that the grout when placed at a fluid consistency shall achieve 95 percent bearing under a 4 foot by 4 foot base plate.
2. Where high fluidity or increased placing time is required, furnish test data from an independent laboratory indicating that the grout when placed at a fluid consistency shall achieve 95 percent under an 18 inch by 36 inch base plate.

U. Adhesive Binder: ASTM C881.

**2.3 CONCRETE MIXES:**

- A. Mix Designs: Proportioned in accordance with Section 5.3, "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318.
1. If trial mixes are used, make a set of at least 6 cylinders in accordance with ASTM C192 for test purposes from each trial mix; test three for compressive strength at 7 days and three at 28 days.
  2. Submit a report of results of each test series, include a detailed listing of the proportions of trial mix or mixes, including cement, fly ash, admixtures, weight of fine and coarse aggregate per m<sup>3</sup> (cubic yard) measured dry rodded and damp loose, specific gravity, fineness modulus, percentage of moisture, air content, water-cement, -fly ash ratio, and consistency of each cylinder in terms of slump.
  3. Prepare a curve showing relationship between water-cement -fly ash ratio at 7-day and 28-day compressive strengths. Plot each curve using at least three specimens.
  4. If the field experience method is used, submit complete standard deviation analysis.

- B. Fly Ash Testing: Submit certificate verifying conformance with ASTM 618 initially with mix design and for each truck load of fly ash delivered from source. Submit test results performed within 6 months of submittal date. Notify COR immediately when change in source is anticipated.
  - 1. Testing Laboratory used for fly ash certification/testing shall participate in the Cement and Concrete Reference Laboratory (CCRL) program. Submit most recent CCRL inspection report.
- C. After approval of mixes no substitution in material or change in proportions of approval mixes may be made without additional tests and approval of COR or as specified. Making and testing of preliminary test cylinders may be carried on pending approval of cement and fly ash , providing Contractor and manufacturer certify that ingredients used in making test cylinders are the same. COR may allow Contractor to proceed with depositing concrete for certain portions of work, pending final approval of cement and fly ash and approval of design mix.
- D. Cement Factor: Maintain minimum cement factors in Table I regardless of compressive strength developed above minimums. Use Fly Ash as an admixture with 20% replacement by weight in all structural work. Increase this replacement to 40% for mass concrete, and reduce it to 10% for drilled piers and caissons. Fly ash shall not be used in high-early mix design.

**TABLE I - CEMENT AND WATER FACTORS FOR CONCRETE**

Concrete Strength		Non-Air-Entrained	Air-Entrained	
Min. 28 Day Comp. Str. psi	Min. Cement lbs/c. yd	Max. Water Cement Ratio	Min. Cement lbs/c. yd	Max. Water Cement Ratio
5000 <sup>1,2</sup>	630	0.45	650	0.40
4000 <sup>1,2</sup>	550	0.55	570	0.50
3000 <sup>1,2</sup>	470	0.65	490	0.55
		*	520	*

1. If trial mixes are used, the proposed mix design shall achieve a compressive strength 1200 psi in excess of f'c. For concrete strengths above 5000 psi, the proposed mix design shall achieve a compressive strength 1400 psi in excess of f'c.
  2. For concrete exposed to high sulfate content soils maximum water cement ratio is 0.44.
- E. Maximum Slump: Maximum slump, as determined by ASTM C143 with tolerances as established by ASTM C94, for concrete to be vibrated shall be as shown in Table II.

**TABLE II - MAXIMUM SLUMP, MM (INCHES)\***

Type of Construction	Normal Weight Concrete	
Slabs	4 inches	

- F. Slump may be increased by the use of the approved high-range water-reducing admixture (superplasticizer). Tolerances as established by ASTM C94. Concrete containing the high-range-water-reducing admixture may have a maximum slump of 9 inches. The concrete shall arrive at the job site at a slump of 2 inches to 3 inches, and This should be verified, and then the high-range-water-reducing admixture added to increase the slump to the approved level.
- G. Air-Entrainment: Air-entrainment of normal weight concrete shall conform with Table III. Air-entrainment of lightweight structural concrete shall conform with Table IV. Determine air content by either ASTM C173 or ASTM C231.

**TABLE III - TOTAL AIR CONTENT  
FOR VARIOUS SIZES OF COARSE AGGREGATES (NORMAL CONCRETE)**

Nominal Maximum Size of Total Air Content	Coarse Aggregate, mm (Inches) Percentage by Volume
3/8 in.6 to 10	1/2 in.5 to 9
3/4 in.4 to 8	1 in.3-1/2 to 6-1/2
1 1/2 in.3 to 6	

- H. High early strength concrete, made with Type III cement or Type I cement plus non-corrosive accelerator, shall have a 7-day compressive strength equal to specified minimum 28-day compressive strength for concrete type specified made with standard Portland cement.
- I. Concrete slabs placed at air temperatures below 10 degrees C (50 degrees Fahrenheit) use non-corrosive, non-chloride accelerator. Concrete required to be air entrained use approved air entraining admixture. Pumped concrete, synthetic fiber concrete, architectural concrete, concrete required to be watertight, and concrete with a water/cement ratio below 0.50 use high-range water-reducing admixture (superplasticizer).
- J. Enforcing Strength Requirements: Test as specified in Section 01 45 29, TESTING LABORATORY SERVICES, during the progress of the work. Seven-day tests may be used as indicators of 28-day strength. Average of any three 28-day consecutive strength tests of laboratory-cured specimens representing each type of concrete shall be equal to or greater than specified strength. No single test shall be more than 500 psi below specified strength. Interpret field test results in accordance with ACI 214. Should strengths shown by test specimens fall below required values, COR may require any one or any combination of the following corrective actions, at no additional cost to the Government:
1. Require changes in mix proportions by selecting one of the other appropriate trial mixes or changing proportions, including cement content, of approved trial mix.
  2. Require additional curing and protection.
  3. If five consecutive tests fall below 95 percent of minimum values given in Table I or if test results are so low as to raise a question as to the safety of the structure, COR may direct Contractor to take cores from portions of the structure. Use results from cores tested by the Contractor retained testing agency to analyze structure.
  4. If strength of core drilled specimens falls below 85 percent of minimum value given in Table I, COR may order load tests, made by Contractor retained testing agency, on portions of building so affected. Load tests in accordance with ACI 318 and criteria of acceptability of concrete under test as given therein.
  5. Concrete work, judged inadequate by structural analysis, by results of load test, or for any reason, shall be reinforced with additional construction or replaced, if directed by the COR.

## 2.4 BATCHING AND MIXING:

- A. General: Concrete shall be "Ready-Mixed" and comply with ACI 318 and ASTM C94. With each batch of concrete, furnish certified delivery tickets listing information in Paragraph 16.1 and 16.2 of ASTM C94. Maximum delivery temperature of concrete is 100 degrees Fahrenheit. Minimum delivery temperature as follows:

Atmospheric Temperature	Minimum Concrete Temperature
30 degrees to 40 degrees F	60 degrees F.
0 degrees to 30 degrees F.	70 degrees F.

1. Services of aggregate manufacturer's representative shall be furnished during the design of trial mixes and as requested by the COR for consultation during batching, mixing, and placing operations of lightweight structural concrete. Services will be required until field controls indicate that concrete of required quality is being furnished. Representative shall be thoroughly familiar with the structural lightweight aggregate, adjustment and control of mixes to produce concrete of required quality. Representative shall assist and advise COR.

## PART 3 – EXECUTION

### 3.1 FORMWORK:

- A. General: Design in accordance with ACI 347 is the responsibility of the Contractor.  
Form boards and plywood forms may be reused for contact surfaces of exposed concrete only if thoroughly cleaned, patched, and repaired and COR approves their reuse.
- B. Treating and Wetting: Treat or wet contact forms as follows:
1. Coat plywood and board forms with non-staining form sealer. In hot weather, cool forms by wetting with cool water just before concrete is placed.
  2. Clean and coat removable metal forms with light form oil before reinforcement is placed. In hot weather, cool metal forms by thoroughly wetting with water just before placing concrete.
  3. Use sealer on reused plywood forms as specified for new material.
- C. Size and Spacing of Studs: Size and space studs, wales and other framing members for wall forms so as not to exceed safe working stress of kind of lumber used nor to develop deflection greater than 1/270 of free span of member.
- D. Unlined Forms: Use plywood forms to obtain a smooth finish for concrete surfaces. Tightly butt edges of sheets to prevent leakage. Back up all vertical joints solidly and nail edges of adjacent sheets to same stud with 6d box nails spaced not over 6 inches apart.
- E. Wall Form Ties: Locate wall form ties in symmetrically level horizontal rows at each line of wales and in plumb vertical tiers. Space ties to maintain true, plumb surfaces. Provide one row of ties within 6 inches above each construction joint. Space through-ties adjacent to horizontal and vertical construction joints not over 18 inches- on center.



1. Tighten row of ties at bottom of form just before placing concrete and, if necessary, during placing of concrete to prevent seepage of concrete and to obtain a clean line. Ties to be entirely removed shall be loosened 24 hours after concrete is placed and shall be pulled from least important face when removed.
  2. Coat surfaces of all metal that is to be removed with paraffin, cup grease or a suitable compound to facilitate removal.
- F. Inserts, Sleeves, and Similar Items: Flashing reglets, steel strips, masonry ties, anchors, , inserts, , sleeves, drains, guard angles, inserts or bond blocks for elevator guide rails and supports, and other items specified as furnished under this and other sections of specifications and required to be in their final position at time concrete is placed shall be properly located, accurately positioned, and built into construction, and maintained securely in place.
- 1 Install sleeves, inserts and similar items for mechanical services in accordance with drawings prepared specially for mechanical services. Contractor is responsible for accuracy and completeness of drawings and shall coordinate requirements for mechanical services and equipment.
  2. Minimum clear distance of embedded items such as conduit and pipe is at least three times diameter of conduit or pipe, except at stub-ups and other similar locations.
  3. Provide recesses and block-outs in floor slabs for door closers and other hardware as necessary in accordance with manufacturer's instructions.
- G. Construction Tolerances:
1. Set and maintain concrete formwork to assure erection of completed work within tolerances specified and to accommodate installation of other rough and finish materials. Accomplish remedial work necessary for correcting excessive tolerances. Erected work that exceeds specified tolerance limits shall be remedied or removed and replaced, at no additional cost to the Government.
  2. Permissible surface irregularities for various classes of materials are defined as "finishes" in specification sections covering individual materials. They are to be distinguished from tolerances specified which are applicable to surface irregularities of structural elements.

### **3.2 PLACING REINFORCEMENT:**

- A. General: Details of concrete reinforcement in accordance with ACI 318 unless otherwise shown.
- B. Placing: Place reinforcement conforming to CRSI DA4, unless otherwise shown.
  1. Place reinforcing bars accurately and tie securely at intersections and splices with 16 gauge black annealed wire. Secure reinforcing bars against displacement during the placing of concrete by spacers, chairs, or other similar supports. Portions of supports, spacers, and chairs in contact with formwork shall be made of plastic in areas that will be exposed when building is occupied. Type, number, and spacing of supports conform to ACI 318. Where

- concrete slabs are placed on ground, use concrete blocks or other non-corrodible material of proper height, for support of reinforcement. Use of brick or stone supports will not be permitted.
- C. Spacing: Minimum clear distances between parallel bars, except in columns and multiple layers of bars in beams shall be equal to nominal diameter of bars. Minimum clear spacing is 25 mm (1 inch) or 1-1/3 times maximum size of coarse aggregate.
- D. Splicing: Splices of reinforcement made only as required or shown or specified. Accomplish splicing as follows:
1. Lap splices: Do not use lap splices for bars larger than Number 11. Minimum lengths of lap as shown.
  2. Welded splices: Not Permitted.
  3. Mechanical Splices: Develop in tension and compression at least 125 percent of the yield strength ( $f_y$ ) of the bars. Stresses of transition splices between two reinforcing bar sizes based on area of smaller bar. Provide mechanical splices at locations indicated. Use approved exothermic, tapered threaded coupling, or swaged and threaded sleeve. Exposed threads and swaging in the field not permitted.
    - a. Initial qualification: In the presence of COR, make three test mechanical splices of each bar size proposed to be spliced. Department of Veterans Affairs retained testing laboratory will perform load test.
    - b. During installation: Furnish, at no additional cost to the Government, one companion (sister) splice for every 50 splices for load testing. Department of Veterans Affairs retained testing laboratory will perform the load test.
- E. Bending: Bend bars cold, unless otherwise approved. Do not field bend bars partially embedded in concrete except as noted F. Cleaning: Metal reinforcement, at time concrete is placed, shall be free from loose flaky rust, mud, oil, or similar coatings that will reduce bond.

### **3.3 VAPOR BARRIER:**

- A. Except where membrane waterproofing is required, interior concrete slab on grade shall be placed on a continuous vapor barrier.
1. Place 4 inches of fine granular fill over the vapor barrier to act as a blotter for concrete slab.
  2. Vapor barrier joints lapped 6 inches and sealed with compatible waterproof pressure-sensitive tape.
  3. Patch punctures and tears.

### **3.4 SLABS RECEIVING RESILIENT COVERING**

- A. Slab shall be allowed to cure for 6 weeks minimum prior to placing resilient covering. After curing, slab shall be tested by the Contractor for moisture in accordance with ASTM D4263 or ASTM F1869. Moisture content shall be less than 3 pounds per 1000 sf prior to placing covering.

- B. In lieu of curing for 6 weeks, Contractor has the option, at his own cost, to utilize the Moisture Vapor Emissions & Alkalinity Control Sealer as follows:
1. Sealer is applied on the day of the concrete pour or as soon as harsh weather permits, prior to any other chemical treatments for concrete slabs either on grade, below grade or above grade receiving resilient flooring, such as, sheet vinyl, vinyl composition tile, rubber, wood flooring, epoxy coatings and overlays.
  2. Manufacturer's representative will be on the site the day of concrete pour to install or train its application and document. He shall return on every application thereafter to verify that proper procedures are followed.
    - a. Apply Sealer to concrete slabs as soon as final finishing operations are complete and the concrete has hardened sufficiently to sustain floor traffic without damage.
    - b. Spray apply Sealer at the rate of 200 square feet per gallon. Lightly broom product evenly over the substrate and product has completely penetrated the surface.
    - c. If within two (2) hours after initial application areas are subjected to heavy rainfall and puddling occurs, reapply Sealer product to these areas as soon as weather condition permits.

### **3.5 CONSTRUCTION JOINTS:**

- A. Unless otherwise shown, location of construction joints to limit individual placement shall not exceed 80 feet in any horizontal direction, except slabs on grade which shall have construction joints shown. Allow 48 hours to elapse between pouring adjacent sections unless this requirement is waived by COR.
- B. Locate construction joints in suspended floors near the quarter-point of spans for slabs, beams or girders, unless a beam intersects a girder at center, in which case joint in girder shall be offset a distance equal to twice width of beam. Provide keys and inclined dowels as shown. Provide longitudinal keys as shown.
- C. Place concrete for columns slowly and in one operation between joints. Install joints in concrete columns at underside of deepest beam or girder framing into column.
- D. Allow 2 hours to elapse after column is cast before concrete of supported beam, girder or slab is placed. Place girders, beams, grade beams, column capitals, brackets, and haunches at the same time as slab unless otherwise shown.

### **3.7 PLACING CONCRETE:**

- A. Preparation:
1. Remove hardened concrete, wood chips, shavings and other debris from forms.
  2. Remove hardened concrete and foreign materials from interior surfaces of mixing and conveying equipment.
  3. Have forms and reinforcement inspected and approved by COR before depositing concrete.

4. Provide runways for wheeling equipment to convey concrete to point of deposit. Keep equipment on runways which are not supported by or bear on reinforcement. Provide similar runways for protection of vapor barrier on coarse fill.
- B. Bonding: Before depositing new concrete on or against concrete which has been set, thoroughly roughen and clean existing surfaces of laitance, foreign matter, and loose particles.
  1. Preparing surface for applied topping:
    - a. Remove laitance, mortar, oil, grease, paint, or other foreign material by sand blasting. Clean with vacuum type equipment to remove sand and other loose material.
    - b. Broom clean and keep base slab wet for at least four hours before topping is applied.
    - c. Use a thin coat of one part Portland cement, 1.5 parts fine sand, bonding admixture; and water at a 50: 50 ratio and mix to achieve the consistency of thick paint. Apply to a damp base slab by scrubbing with a stiff fiber brush. New concrete shall be placed while the bonding grout is still tacky.
- C. Conveying Concrete: Convey concrete from mixer to final place of deposit by a method which will prevent segregation. Method of conveying concrete is subject to approval of COR.
- D. Placing: For special requirements see Paragraphs, HOT WEATHER and COLD WEATHER.
  1. Do not place concrete when weather conditions prevent proper placement and consolidation, or when concrete has attained its initial set, or has contained its water or cement content more than 1 1/2 hours.
  2. Deposit concrete in forms as near as practicable in its final position. Prevent splashing of forms or reinforcement with concrete in advance of placing concrete.
  3. Do not drop concrete freely more than 3000 mm (10 feet) for concrete containing the high-range water-reducing admixture (superplasticizer) or 1500 mm (5 feet) for conventional concrete. Where greater drops are required, use a tremie or flexible spout (canvas elephant trunk), attached to a suitable hopper.
  4. Discharge contents of tremies or flexible spouts in horizontal layers not exceeding 500 mm (20 inches) in thickness, and space tremies such as to provide a minimum of lateral movement of concrete.
  5. Continuously place concrete until an entire unit between construction joints is placed. Rate and method of placing concrete shall be such that no concrete between construction joints will be deposited upon or against partly set concrete, after its initial set has taken place, or after 45 minutes of elapsed time during concrete placement.
  6. On bottom of members with severe congestion of reinforcement, deposit 25 mm (1 inch) layer of flowing concrete containing the specified high-range water-reducing admixture (superplasticizer). Successive concrete lifts may be a continuation of this concrete or concrete with a conventional slump.

7. Concrete on metal deck:
  - a. Concrete on metal deck shall be minimum thickness shown. Allow for deflection of steel beams and metal deck under the weight of wet concrete in calculating concrete quantities for slab.
    - 1) The Contractor shall become familiar with deflection characteristics of structural frame to include proper amount of additional concrete due to beam/deck deflection.
- E. Consolidation: Conform to ACI 309. Immediately after depositing, spade concrete next to forms, work around reinforcement and into angles of forms, tamp lightly by hand, and compact with mechanical vibrator applied directly into concrete at approximately 450 mm (18 inch) intervals. Mechanical vibrator shall be power driven, hand operated type with minimum frequency of 5000 cycles per minute having an intensity sufficient to cause flow or settlement of concrete into place. Vibrate concrete to produce thorough compaction, complete embedment of reinforcement and concrete of uniform and maximum density without segregation of mix. Do not transport concrete in forms by vibration.
  1. Use of form vibration shall be approved only when concrete sections are too thin or too inaccessible for use of internal vibration.
  2. Carry on vibration continuously with placing of concrete. Do not insert vibrator into concrete that has begun to set.

### **3.8 HOT WEATHER:**

Follow the recommendations of ACI 305 or as specified to prevent problems in the manufacturing, placing, and curing of concrete that can adversely affect the properties and serviceability of the hardened concrete. Methods proposed for cooling materials and arrangements for protecting concrete shall be made in advance of concrete placement and approved by COR.

### **3.9 COLD WEATHER:**

Follow the recommendations of ACI 306 or as specified to prevent freezing of concrete and to permit concrete to gain strength properly. Use only the specified non-corrosive, non-chloride accelerator. Do not use calcium chloride, thiocyanates or admixtures containing more than 0.05 percent chloride ions. Methods proposed for heating materials and arrangements for protecting concrete shall be made in advance of concrete placement and approved by COR.

### **3.10 PROTECTION AND CURING:**

- A. Conform to ACI 308: Initial curing shall immediately follow the finishing operation. Protect exposed surfaces of concrete from premature drying, wash by rain and running water, wind, mechanical injury, and excessively hot or cold temperatures. Keep concrete not covered with membrane or other curing material continuously wet for at least 7 days after placing, except wet curing period for high-early-strength concrete shall be not less than 3 days. Keep wood forms

continuously wet to prevent moisture loss until forms are removed. Cure exposed concrete surfaces as described below. Other curing methods may be used if approved by COR.

1. Liquid curing and sealing compounds: Apply by power-driven spray or roller in accordance with the manufacturer's instructions. Apply immediately after finishing. Maximum coverage 10m<sup>2</sup>/L (400 square feet per gallon) on steel troweled surfaces and 7.5m<sup>2</sup>/L (300 square feet per gallon) on floated or broomed surfaces for the curing/sealing compound.
2. Plastic sheets: Apply as soon as concrete has hardened sufficiently to prevent surface damage. Utilize widest practical width sheet and overlap adjacent sheets 50 mm (2 inches). Tightly seal joints with tape.
3. Paper: Utilize widest practical width paper and overlap adjacent sheets 50 mm (2 inches). Tightly seal joints with sand, wood planks, pressure-sensitive tape, mastic or glue.

### **3.11 REMOVAL OF FORMS:**

- A. Remove in a manner to assure complete safety of structure after the following conditions have been met.
  1. Where structure as a whole is supported on shores, forms for beams and girder sides, columns, and similar vertical structural members may be removed after 24 hours, provided concrete has hardened sufficiently to prevent surface damage and curing is continued without any lapse in time as specified for exposed surfaces.
  2. Take particular care in removing forms of architectural exposed concrete to insure surfaces are not marred or gouged, and that corners and arises are true, sharp and unbroken.
- B. Control Test: Use to determine if the concrete has attained sufficient strength and curing to permit removal of supporting forms. Cylinders required for control tests taken in accordance with ASTM C172, molded in accordance with ASTM C31, and tested in accordance with ASTM C39. Control cylinders cured and protected in the same manner as the structure they represent. Supporting forms or shoring not removed until strength of control test cylinders have attained at least 70 percent of minimum 28-day compressive strength specified. Exercise care to assure that newly unsupported portions of structure are not subjected to heavy construction or material loading.

### **3.12 CONCRETE SURFACE PREPARATION:**

- A. Metal Removal: Unnecessary metal items cut back flush with face of concrete members.
- B. Patching: Maintain curing and start patching as soon as forms are removed. Do not apply curing compounds to concrete surfaces requiring patching until patching is completed. Use cement mortar for patching of same composition as that used in concrete. Use white or gray Portland cement as necessary to obtain finish color matching surrounding concrete. Thoroughly clean areas to be patched. Cut out honeycombed or otherwise defective areas to solid concrete to a depth of not less than 25 mm (1 inch). Cut edge perpendicular to surface of concrete. Saturate with water area to be patched, and at least 150 mm (6 inches) surrounding before placing patching mortar. Give area to be patched a brush coat of cement grout followed immediately by

patching mortar. Cement grout composed of one part Portland cement, 1.5 parts fine sand, bonding admixture, and water at a 50:50 ratio, mix to achieve consistency of thick paint. Mix patching mortar approximately 1 hour before placing and remix occasionally during this period without addition of water. Compact mortar into place and screed slightly higher than surrounding surface. After initial shrinkage has occurred, finish to match color and texture of adjoining surfaces. Cure patches as specified for other concrete. Fill form tie holes which extend entirely through walls from unexposed face by means of a pressure gun or other suitable device to force mortar through wall. Wipe excess mortar off exposed face with a cloth.

- C. Upon removal of forms, clean vertical concrete surface that is to receive bonded applied cementitious application with wire brushes or by sand blasting to remove unset material, laitance, and loose particles to expose aggregates to provide a clean, firm, granular surface for bond of applied finish.

### **3.13 CONCRETE FINISHES:**

A. Vertical and Overhead Surface Finishes:

1. Unfinished areas: Vertical and overhead concrete surfaces exposed in pipe basements, elevator and dumbwaiter shafts, pipe spaces, pipe trenches, above suspended ceilings, manholes, and other unfinished areas will not require additional finishing.
2. Interior and exterior exposed areas to be painted: Remove fins, burrs and similar projections on surfaces flush, and smooth by mechanical means approved by COR, and by rubbing lightly with a fine abrasive stone or hone. Use ample water during rubbing without working up a lather of mortar or changing texture of concrete.
3. Interior and exterior exposed areas finished: Give a grout finish of uniform color and smooth finish treated as follows:
  - a. After concrete has hardened and laitance, fins and burrs removed, scrub concrete with wire brushes. Clean stained concrete surfaces by use of a hone stone.
  - b. Apply grout composed of one part of Portland cement, one part fine sand, smaller than a 600  $\mu\text{m}$  (No. 30) sieve. Work grout into surface of concrete with cork floats or fiber brushes until all pits, and honeycombs are filled.
  - c. After grout has hardened slightly, but while still plastic, scrape grout off with a sponge rubber float and, about 1 hour later, rub concrete vigorously with burlap to remove any excess grout remaining on surfaces.
  - d. In hot, dry weather use a fog spray to keep grout wet during setting period. Complete finish of area in same day. Make limits of finished areas at natural breaks in wall surface. Leave no grout on concrete surface overnight.
4. Textured: Finish as specified. Maximum quantity of patched area 0.2  $\text{m}^2$  (2 square feet) in each 93  $\text{m}^2$  (1000 square feet) of textured surface.

B. Slab Finishes:

1. Monitoring and Adjustment: Provide continuous cycle of placement, measurement, evaluation and adjustment of procedures to produce slabs within specified tolerances. Monitor elevations of structural steel in key locations before and after concrete placement to establish typical deflection patterns for the structural steel. Determine elevations of cast-in-place slab soffits prior to removal of shores. Provide information to COR and floor consultant for evaluation and recommendations for subsequent placements.
2. Set perimeter forms to serve as screed using either optical or laser instruments. For slabs on grade, wet screeds may be used to establish initial grade during strike-off, unless COR determines that the method is proving insufficient to meet required finish tolerances and directs use of rigid screed guides. Where wet screeds are allowed, they shall be placed using grade stakes set by optical or laser instruments. Use rigid screed guides, as opposed to wet screeds, to control strike-off elevation for all types of elevated (non slab-on-grade) slabs. Divide bays into halves or thirds by hard screeds. Adjust as necessary where monitoring of previous placements indicates unshored structural steel deflections to other than a level profile.
3. Place slabs monolithically. Once slab placement commences, complete finishing operations within same day. Slope finished slab to floor drains where they occur, whether shown or not.
4. Use straightedges specifically made for screeding, such as hollow magnesium straightedges or power strike-offs. Do not use pieces of dimensioned lumber. Strike off and screed slab to a true surface at required elevations. Use optical or laser instruments to check concrete finished surface grade after strike-off. Repeat strike-off as necessary. Complete screeding before any excess moisture or bleeding water is present on surface. Do not sprinkle dry cement on the surface.
5. Immediately following screeding, and before any bleed water appears, use a 3000 mm (10 foot) wide highway straightedge in a cutting and filling operation to achieve surface flatness. Do not use bull floats or darbys, except that darbying may be allowed for narrow slabs and restricted spaces.
6. Wait until water sheen disappears and surface stiffens before proceeding further. Do not perform subsequent operations until concrete will sustain foot pressure with maximum of 6 mm (1/4 inch) indentation.
7. Scratch Finish: Finish base slab to receive a bonded applied cementitious application as indicated above, except that bull floats and darbys may be used. Thoroughly coarse wire broom within two hours after placing to roughen slab surface to insure a permanent bond between base slab and applied materials.
8. Float Finish: Slabs to receive unbonded toppings, steel trowel finish, fill, mortar setting beds, or a built-up roof, and ramps, stair treads, platforms (interior and exterior), and equipment pads shall be floated to a smooth, dense uniform, sandy textured finish. During floating, while



- surface is still soft, check surface for flatness using a 3000 mm (10 foot) highway straightedge. Correct high spots by cutting down and correct low spots by filling in with material of same composition as floor finish. Remove any surface projections and re-float to a uniform texture.
9. Steel Trowel Finish: Concrete surfaces to receive resilient floor covering or carpet, monolithic floor slabs to be exposed to view in finished work, future floor roof slabs, applied toppings, and other interior surfaces for which no other finish is indicated. Steel trowel immediately following floating. During final troweling, tilt steel trowel at a slight angle and exert heavy pressure to compact cement paste and form a dense, smooth surface. Finished surface shall be smooth, free of trowel marks, and uniform in texture and appearance.
  10. Broom Finish: Finish exterior slabs, ramps, and stair treads with a bristle brush moistened with clear water after surfaces have been floated. Brush in a direction transverse to main traffic. Match texture approved by COR from sample panel.
  11. Finished slab flatness shall be no greater than 3/16" over a 10 foot straightedge.
  12. Remedial Measures for Rejected Slabs: Correct rejected slab areas by grinding, planing, surface repair with underlayment compound or repair topping, retopping, or removal and replacement of entire rejected slab areas, as directed by COR, until a slab finish constructed within specified tolerances is accepted.

### **3.14 SURFACE TREATMENTS:**

- A. Use on exposed concrete floors and concrete floors to receive carpeting except those specified to receive non-slip finish.
- B. Liquid Densifier/Sealer: Apply in accordance with manufacturer's directions just prior to completion of construction.
- C. Non-Slip Finish: Except where safety nosing and tread coverings are shown, apply non-slip abrasive aggregate to treads and platforms of concrete steps and stairs, and to surfaces of exterior concrete ramps and platforms. Broadcast aggregate uniformly over concrete surface at rate of application of 8% per 1/10th m<sup>2</sup> (7.5 percent per square foot) of area. Trowel concrete surface to smooth dense finish. After curing, rub treated surface with abrasive brick and water to slightly expose abrasive aggregate.

--- E N D ---

**SECTION 04 05 13  
MASONRY MORTARING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Masonry mortar installed by other masonry sections.

**1.2 RELATED REQUIREMENTS**

- A. Mortar used in Section:
  - 1. Section 04 05 16, MASONRY GROUTING.
  - 2. Section 04 20 00, UNIT MASONRY.

**1.3 APPLICABLE PUBLICATIONS**

- A. Comply with references to extent specified in this section.
- B. ASTM International (ASTM):
  - 1. C40/C40M-11 - Organic Impurities in Fine Aggregates for Concrete.
  - 2. C91/C91M-12 - Masonry Cement.
  - 3. C144-11 -Aggregate for Masonry Mortar.
  - 4. C150/C150M-15 - Portland Cement.
  - 5. C207-06(2011) - Hydrated Lime for Masonry Purposes.
  - 6. C270-14a - Mortar of Unit Masonry.
  - 7. C595/C595M-15e1 - Blended Hydraulic Cements.
  - 8. C780-15 - Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
  - 9. C979/C979M-10 - Pigments for Integrally Colored Concrete.
  - 10. C1329/C1329M-15 - Mortar Cement.

**1.4 SUBMITTALS**

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
  - 1. Description of each product.
- C. Not Used
- D. Certificates: Certify each product complies with specifications.
  - 1. Portland cement.
  - 2. Masonry cement.
  - 3. Mortar cement.
  - 4. Hydrated lime.
  - 5. Fine aggregate.
  - 6. Color admixture.

- E. Qualifications: Substantiate qualifications comply with specifications.
  - 1. Testing laboratory.

## **1.5 NOT USED**

## **1.6 DELIVERY**

- A. Deliver products in manufacturer's original sealed packaging.
- B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, color, production run number, and manufacture date.
- C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

## **1.7 STORAGE AND HANDLING**

- A. Store masonry materials under waterproof covers on planking clear of ground.
  - 1. Protect loose, bulk materials from contamination.
- B. Protect products from damage during handling and construction operations.

## **1.8 WARRANTY**

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

# **PART 2 - PRODUCTS**

## **2.1 MATERIALS**

- A. Hydrated Lime: ASTM C207, Type S.
- B. Aggregate for Masonry Mortar: ASTM C144 and as follows:
  - 1. Light colored sand for mortar for laying face brick.
  - 2. White plastering sand meeting sieve analysis for mortar joints for pointing except that 100 percent passes No. 8 sieve, and maximum 5 percent retained on No. 16 sieve.
  - 3. Test sand for color value according to ASTM C40/C40M. Sand producing color darker than specified standard is unacceptable.
- C. Blended Hydraulic Cement: ASTM C595/C595M, Type IS, IP.
- D. Masonry Cement: ASTM C91/C91M. Type N, S, Or M.
  - 1. Use white masonry cement whenever white mortar is specified.
- E. Mortar Cement: ASTM C1329/C1329M, Type N, S or M.
- F. Portland Cement: ASTM C150/C150M, Type I.
  - 1. Use white Portland cement wherever white mortar is specified.
- G. Pigments: ASTM C979/C979M; inorganic, inert, mineral pigments only, unaffected by atmospheric conditions, nonfading, alkali resistant, and water insoluble.
- H. Water: Potable, free of substances that are detrimental to mortar, masonry, and metal.

## **2.2 PRODUCTS - GENERAL**

- A. Provide each product from one manufacturer.

## **2.3 MIXES**

- A. Pointing Mortar for New Work:
  - 1. For Cast Stone or Precast Concrete: Proportion by volume; one part white Portland cement, two parts white sand, and 1/5 part hydrated lime.
  - 2. Pointing Mortar for Glazed Structural Facing Tile:
    - a. Proportion by volume: One part white Portland cement, two parts of graded white sand passing Number 50 sieve, and 1/8 part hydrated lime.
- B. Not Used.
- C. Masonry Mortar: ASTM C270.
  - 1. Admixtures:
    - a. Do not use mortar admixtures, and color admixtures unless approved by Contracting Officer's Representative.
    - b. Do not use antifreeze compounds.
- D. Not Used
- E. Not Used

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Examine and verify substrate suitability for product installation.
- B. Protect existing construction and completed work from damage.

### **3.2 MIXING**

- A. Measure ingredients by volume using known capacity container.
- B. Mix for 3 to 5 minutes in a mechanically operated mortar mixer.
- C. Mix water with dry ingredients in sufficient amount to provide a workable mixture which will adhere to vertical surfaces of masonry units.
- D. Mortar Stiffened Because of Water Loss Through Evaporation:
  - 1. Re-temper by adding water to restore to proper consistency and workability.
  - 2. Discard mortar reaching initial set or unused within two hours of mixing.
- E. Pointing Mortar:
  - 1. Mix dry ingredients with enough water to produce damp mixture of workable consistency retaining shape when formed into ball.
  - 2. Allow mortar to stand in dampened condition for 60 to 90 minutes.
  - 3. Add water to bring mortar to a workable consistency before use.

### **3.3 MORTARING**

- A. Hydrated Lime: ASTM C207/C207M, Type S.
- B. Aggregate for Masonry Mortar: ASTM C144/C144M and as follows:
  - 1. Light colored sand for mortar for laying face brick.

2. Test sand for color value according to ASTM C40/C40M. Sand producing color darker than specified standard is unacceptable.
- C. Blended Hydraulic Cement: ASTM C595/C595M, Type IS, IP.
- D. Masonry Cement: ASTM C91/C91M. Type N, S, Or M.
- E. Mortar Cement: ASTM C1329/C1329M, Type N, S or M.
- F. Portland Cement: ASTM C150/C150M, Type I.
  1. Use white Portland cement wherever white mortar is specified.
- G. Pigments: ASTM C979/C979M; inorganic, inert, mineral pigments only, unaffected by atmospheric conditions, nonfading, alkali resistant, and water insoluble.
- H. Water: Potable, free of substances that are detrimental to mortar, masonry, and metal

-- E N D --

**SECTION 04 05 16  
MASONRY GROUTING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Grout for filling hollow concrete masonry cores.

**1.2 RELATED REQUIREMENTS**

- A. Grout used in Section:
  - 1. Section 04 20 00, UNIT MASONRY.

**1.3 APPLICABLE PUBLICATIONS**

- A. Comply with references to extent specified in this section.
- B. American National Standards Institute (ANSI):
  - 1. A118.6-10 - Standard Cement Grouts for Tile Installation.
- C. ASTM International (ASTM):
  - 1. C40/C40M-11 - Organic Impurities in Fine Aggregates for Concrete.
  - 2. C150/C150M-15 - Portland Cement.
  - 3. C207-06(2011) - Hydrated Lime for Masonry Purposes.
  - 4. C404-11 - Aggregates for Masonry Grout.
  - 5. C476-11 - Grout for Masonry.
  - 6. C595/C595M-15e1 - Blended Hydraulic Cement.
  - 7. C979/C979M-10 - Pigments for Integrally Colored Concrete.
  - 8. C1019-14 - Sampling and Testing Grout.

**1.4 SUBMITTALS**

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
  - 1. Description of each product.
- C. Test Reports: Certify each product complies with specifications.
  - 1. Grout, each type.
  - 2. Cement.
  - 3. Aggregate.
- D. Certificates: Certify each product complies with specifications.
  - 1. Blended hydraulic cement.
  - 2. Portland cement.
  - 3. Grout.
  - 4. Hydrated lime.
  - 5. Aggregate.

6. Color admixture.

## **1.5 NOT USED**

## **1.6 DELIVERY**

- A. Deliver products in manufacturer's original sealed packaging.
- B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, production run number, and manufacture date.

## **1.7 STORAGE AND HANDLING**

- A. Store masonry materials under waterproof covers on planking clear of ground, and protect damage from handling, dirt, stain, water and wind.
- B. Protect products from damage during handling and construction operations.

## **1.8 WARRANTY**

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

# **PART 2 - PRODUCTS**

## **2.1 MATERIALS**

- A. Grout Components:
  1. Hydrated Lime: ASTM C207, Type S.
  2. Aggregate For Masonry Grout: ASTM C404, Size 8.
  3. Blended Hydraulic Cement: ASTM C595, Type IS, IP.
  4. Portland Cement: ASTM C150, Type I.
  5. Water: Potable, free of substances that are detrimental to grout, masonry, and metal.

## **2.2 PRODUCTS - GENERAL**

- A. Provide each product from one manufacturer.

## **2.3 MIXES**

- A. Grout: ASTM C476; fine grout and coarse grout.
- B. Ready-Mixed Grout: ANSI A118.8.

# **PART 3 - EXECUTION**

## **3.1 PREPARATION**

- A. Examine and verify substrate suitability for product installation.
- B. Protect existing construction and completed work from damage.
- C. Clean mortar from masonry cells protruding more than 13 mm (1/2 inch) to permit grout flow.
- D. Remove debris from grout spaces.
- E. Verify reinforcement is correctly placed before placing grout.

**3.2 MIXING**

- A. Mix grout in mechanically operated mixer.
  - 1. Mix grout for five minutes, minimum.
- B. Measure ingredients by volume using container of known capacity.
- C. Mix water with grout dry ingredients.
  - 1. Slump Range: 200 to 275 mm (8 to 11 inches).

**3.3 GROUTING**

- A. Install grout according to Section 04 20 00, UNIT MASONRY.
- B. Use fine grout for filling wall cavities and hollow concrete masonry units where smallest cell dimension is 50 mm (2 inches) or less.
- C. Use either fine grout or coarse grout for filling wall cavities and hollow concrete masonry units where smallest cell dimension is greater than 50 mm (2 inches).
- D. Use grout for filling bond beam or lintel units.

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**SECTION 04 20 00  
UNIT MASONRY**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes: Concrete masonry unit (CMU) assemblies for:
  - 1. Exterior walls.
  - 2. Interior walls.

**1.2 RELATED REQUIREMENTS**

- A. Sealants and Sealant Installation: Section 07 92 00, JOINT SEALANTS.

**1.3 APPLICABLE PUBLICATIONS**

- A. Comply with references to extent specified in this section.
- B. American Concrete Institute (ACI):
  - 1. 315-99 - Details and Detailing of Concrete Reinforcement.
  - 2. 530.1/ASCE 6/TMS 602-13 - Specification for Masonry Structures.
- C. ASTM International (ASTM):
  - 1. A615/A615M-15ae1 - Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
  - 2. A951/A951M-14 - Steel Wire for Masonry Joint Reinforcement.
  - 3. A1064/A1064M-15 - Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
  - 4. C34-13 - Structural Clay Load-Bearing Wall tile.
  - 5. C55-14a - Concrete Building Brick.
  - 6. C56-13 - Structural Clay Nonloadbearing Tile.
  - 7. C62-13a - Building Brick (Solid Masonry Units Made from Clay or Shale).
  - 8. C67-14 - Sampling and Testing Brick and Structural Clay Tile.
  - 9. C90-14 - Load-Bearing Concrete Masonry Units.
  - 10. C126-15 - Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units.
  - 11. C216-15 - Facing Brick (Solid Masonry Units Made From Clay or Shale).
  - 12. C612-14 - Mineral Fiber Block and Board Thermal Insulation.
  - 13. C744-14 - Prefaced Concrete and Calcium Silicate Masonry Units.
  - 14. D1056-14 - Flexible Cellular Materials - Sponge or Expanded Rubber.
  - 15. D2240-05(2010) - Rubber Property-Durometer Hardness.
  - 16. F1667-15 - Driven Fasteners: Nails, Spikes, and Staples.
- D. American Welding Society (AWS):
  - 1. D1.4/D1.4M-11 - Structural Welding Code - Reinforcing Steel.
- E. Brick Industry Association (BIA):

1. TN 11B-88 - Guide Specifications for Brick Masonry, Part 3.

F. Federal Specifications (Fed. Spec.):

1. FF-S-107C(2) - Screws, Tapping and Drive.

#### **1.4 SUBMITTALS**

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submittal Drawings:
  1. Fabrication, bending, and placement of reinforcing bars. Comply with ACI 315. Show bar schedules, diagrams of bent bars, stirrup spacing, lateral ties and other arrangements and assemblies.
  2. Special masonry shapes, profiles, and placement.
  3. Masonry units for typical window and door openings, and, for special conditions as affected by structural conditions.
- C. Manufacturer's Literature and Data:
  1. Description of each product.
  2. Installation instructions.
- D. Samples:
  1. Face brick: Sample panel, 200 mm by 400 mm (8 inches by 16 inches,) showing full color range and texture of bricks, bond, and proposed mortar joints.
- E. Certificates: Certify products comply with specifications.
  1. Face brick.
  2. Solid and load-bearing concrete masonry units, including fire-resistant rated units.

#### **1.5 Not Used**

#### **1.6 DELIVERY**

- A. Deliver products in manufacturer's original sealed packaging.
- B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, production run number, and manufacture date.
- C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

#### **1.7 STORAGE AND HANDLING**

- A. Store products above grade, protected from contamination.
- B. Protect products from damage during handling and construction operations.

#### **1.8 FIELD CONDITIONS**

- A. Hot and Cold Weather Requirements: Comply with ACI 530.1/ASCE 6/TMS 602.

#### **1.9 WARRANTY**

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

## **PART 2 - PRODUCTS**

### **2.1 Not Used**

### **2.2 PRODUCTS - GENERAL**

- A. Provide each product from one manufacturer and from one production run.

### **2.3 UNIT MASONRY PRODUCTS**

- A. Brick:
1. Face Brick:
    - a. ASTM C216, Grade SW, Type FBS.
    - b. Brick when tested according to ASTM C67: Classified slightly efflorescent or better.
    - c. Size:
      - 1) Modular.
  2. Building Brick: ASTM C62, Grade MW for backup and interior work; Grade SW where in contact with earth.
  3. One Face Exposed: Grade S, Type I.
  4. Two Faces Exposed: Grade S, Type II.
- B. Concrete Masonry Units (CMU):
1. Hollow and Solid Load-Bearing Concrete Masonry Units: ASTM C90.
    - a. Unit Weight: Normal weight.
    - b. Fire rated units for fire rated partitions
  2. Sizes: Modular, 200 mm by 400 mm (8 inches by 16 inches) nominal face dimension; thickness as indicated on drawings.
- C. Concrete Brick: ASTM C55.

### **2.4 ANCHORS, TIES, AND REINFORCEMENT**

- A. Steel Reinforcing Bars: ASTM A615/A615M; Grade 60, deformed bars.
- B. Joint Reinforcement:
1. Form from wire complying with ASTM A951/A951M.
  2. Hot dipped galvanized after fabrication.
  3. Width of joint reinforcement 40 mm (1.6 inches) less than nominal thickness of masonry wall or partition.
  4. Cross wires welded to longitudinal wires.
  5. Joint reinforcement minimum 3000 mm (10 feet) long, factory cut.
  6. Joint reinforcement with crimp formed drip is not acceptable.
  7. Maximum spacing of cross wires 400 mm (16 inch) to longitudinal wires.
  8. Ladder Design:
    - a. Longitudinal wires deformed 5 mm (0.20 inch) diameter wire.
    - b. Cross wires 4 mm (0.16 inch) diameter.

9. Trussed Design:
  - a. Longitudinal and cross wires minimum 4 mm (0.16 inch nominal) diameter.
  - b. Longitudinal wires deformed.
- C. Adjustable Veneer Anchor for Framed Walls:
  1. Two piece, adjustable anchor and tie.
  2. Anchor and tie may be either loop or angle type; provide only one type throughout.
  3. Loop Type:
    - a. Anchor: Screw-on galvanized steel anchor strap 2.75 mm (0.11 inch) by 19 mm (3/4 inch) wide by 225 mm (9 inches) long, with 9 mm (0.35 inch) offset and 100 mm (4 inch) adjustment. Provide 5 mm (0.20 inch) hole at each end for fasteners.
    - b. Ties: Triangular tie, fabricated of 5 mm (0.20 inch) diameter galvanized cold drawn steel wire. Ties long enough to engage anchor and be embedded minimum 50 mm (2 inches) into bed joint of masonry veneer.
  4. Angle Type:
    - a. Anchor: Minimum 2 mm (16 gage) thick galvanized steel angle shaped anchor strap. Provide hole in vertical leg for fastener. Provide hole near end of outstanding leg to suit upstanding portion of tie.
    - b. Tie: Fabricate from 5 mm (0.20 inch) diameter galvanized cold drawn steel wire. Form "L" shape to be embedded minimum 50 mm (2 inches) into the bed joint of masonry veneer and provide upstanding leg to fit through hole in anchor and be long enough to allow 50 mm (2 inches) of vertical adjustment.
- D. Dovetail Anchors:
  1. Corrugated steel dovetail anchors formed of 1.5 mm (0.06 inch) thick by 25 mm (1 inch) wide galvanized steel, 90 mm (3-1/2 inches) long where used to anchor 100 mm (4 inch) nominal thick masonry units, 140 mm (5-1/2 inches) long for masonry units more than 100 mm (4 inches) thick.
  2. Triangular wire dovetail anchor 100 mm (4 inch) wide formed of 4 mm (9 gage) steel wire with galvanized steel dovetail insert. Anchor length to extend minimum 75 mm (3 inches) into masonry, 25 mm (1 inch) into 40 mm (1-1/2 inch) thick units.
  3. Form dovetail anchor slots from 0.6 mm (0.02 inch) thick galvanized steel (with felt or fiber filler).
- E. Individual Ties:
  1. Rectangular ties: Form from 5 mm (3/16 inch) diameter galvanized steel rod to rectangular shape minimum 50 mm (2 inches) wide by sufficient length for ends of ties to extend within 25 mm (1 inch) of each face of wall. Ties that are crimped to form drip are not acceptable.
  2. Adjustable Cavity Wall Ties:
    - a. Adjustable wall ties may be furnished at Contractor's option.

- b. Two piece type permitting up to 40 mm (1-1/2 inch) adjustment.
  - c. Form ties from 5 mm (3/16 inch) diameter galvanized steel wire.
  - d. Form one piece to rectangular shape 105 mm (4-1/8 inches) wide by length required to extend into bed joint 50 mm (2 inches).
  - e. Form other piece to 75 mm (3 inch) long by 75 mm (3 inch) wide shape, having 75 mm (3 inch) long bent section for engaging 105 mm (4-1/8 inch) wide piece to form adjustable connection.
- F. Wall Ties, (Mesh or Wire):
- 1. Mesh wall ties formed of ASTM A1064/A1064M, W0.5, 2 mm, (0.08 inch) galvanized steel wire 13 mm by 13 mm (1/2 inch by 1/2 inch) mesh, 75 mm (3 inches) wide by 200 mm (8 inches) long.
  - 2. Rectangular wire wall ties formed of W1.4, 3 mm, (0.12 inch) galvanized steel wire 50 mm (2 inches) wide by 200 mm (8 inches) long.

## **2.5 ACCESSORIES**

- A. Weeps:
- 1. Weep Hole Wicks: Glass fiber ropes, 10 mm (3/8 inch) minimum diameter, 300 mm (12 inches) long.
  - 2. Weep Tubing: Round, polyethylene, 9 mm (3/8 inch) diameter, 100 mm (4 inches) long.
  - 3. Weep Hole: Flexible PVC louvered configuration with rectangular closure strip at top.
- B. Cavity Drain Material: Open mesh polyester sheets or strips to prevent mortar droppings from clogging the cavity.
- C. Preformed Compressible Joint Filler:
- 1. Thickness and depth to fill joint.
  - 2. Closed Cell Neoprene: ASTM D1056, Type 2, Class A, Grade 1, B2F1.
  - 3. Non-Combustible Type: ASTM C612, Type 5, Max. Temp. 1800 degrees F.
- D. Box Board:
- 1. Mineral Fiber Board: ASTM C612, Type 1.
  - 2. 25 mm (1 inch) thickness.
  - 3. Other spacing material having similar characteristics is acceptable subject to Contracting Officer's Representative's approval.
- E. Masonry Cleaner:
- 1. Detergent type cleaner selected for each type masonry.
  - 2. Acid cleaners are not acceptable.
  - 3. Use soapless type specially prepared for cleaning brick or concrete masonry as appropriate.
- F. Fasteners:
- 1. Concrete Nails: ASTM F1667, Type I, Style 11, 19 mm (3/4 inch) minimum length.
  - 2. Masonry Nails: ASTM F1667, Type I, Style 17, 19 mm (3/4 inch) minimum length.

3. Screws: FS-FF-S-107, Type A, AB, SF thread forming or cutting.
- G. Welding Materials: AWS D1.4/D1.4M, type to suit application.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION - GENERAL**

- A. Install products according to manufacturer's instructions.
  1. When manufacturer's instructions deviate from specifications, submit proposed resolution for Contracting Officer's Representative consideration.
- B. Keep finish work free from mortar smears or spatters, and leave neat and clean.
- C. Wall Openings:
  1. Fill hollow metal frames built into masonry walls and partitions solid with mortar as laying of masonry progresses.
  2. When items are not available when walls are built, prepare openings for subsequent installation.
- D. Tooling Joints:
  1. Do not tool until mortar has stiffened enough to retain thumb print when thumb is pressed against mortar.
  2. Tool while mortar is soft enough to be compressed into joints and not raked out.
  3. Finish joints in exterior face masonry work with jointing tool, and provide smooth, water-tight concave joint unless specified otherwise.
  4. Tool Exposed interior joints in finish work concave unless specified otherwise.
- E. Partition Height:
  1. Extend partitions minimum 100 mm (4 inches) above suspended ceiling or to overhead construction where no ceiling occurs.
  2. Extend following partitions to overhead construction.
    - a. Full height partitions, and fire partitions and smoke partitions indicated on drawings.
    - b. Both walls at expansion joints.
    - c. Corridor walls.
    - d. Walls at stairway and stair halls, elevators, dumbwaiters, trash and laundry chute shafts, and other vertical shafts.
    - e. Reinforced masonry partitions.
  3. Extend finished masonry partitions minimum 100 mm (4 inches) above suspended ceiling and continue with concrete masonry units or structural clay tile to overhead construction:
- F. Lintels:
  1. Lintels are not required for openings less than 1000 mm (40 inches) wide that have hollow metal frames.

2. Precast concrete lintels of 25 MPa (3,000 psi) concrete, same thickness as partition, and with one No. 16 (No. 5) deformed bar top and bottom for each 100 mm (4 inches) of nominal thickness, is acceptable in lieu of reinforced CMU masonry lintels.
  3. Use steel lintels, for openings greater than 1600 mm (63 inches) wide, brick masonry openings, and elevator openings unless shown otherwise.
  4. Doors having overhead concealed door closers require steel lintel, and pocket for closer box.
  5. Lintel Bearing Length: Minimum 100 mm (4 inches) at both ends.
  6. Build masonry openings or arches over wood or metal centering and supports when steel lintels are not used.
- G. Wall, Furring, and Partition Units:
1. Lay out field units to provide one-half running bond, unless indicated otherwise.
  2. Align head joints of alternate vertical courses.
  3. At sides of openings, balance head joints in each course on vertical center lines of openings.
  4. Minimum Masonry Unit Length: 100 mm (4 inches).
  5. On interior partitions provide 6 mm (1/4 inch) open joint for caulking between existing construction.
- H. Before connecting new masonry with previously laid masonry, remove loosened masonry or mortar, and clean and wet work in place as specified under wetting.
- I. Structural Steel Encased in Masonry:
1. Where structural steel is encased in masonry and voids between steel and masonry are filled with mortar, provide minimum 25 mm (1 inch) mortar free expansion space between masonry and steel by applying box board material to steel before masonry is laid.
  2. Do not install spacing material where steel is bearing on masonry or masonry is bearing on steel.
- J. Chases:
1. Do not install chases in masonry walls and partitions exposed to view in finished work, including painted or coated finishes on masonry.
  2. Masonry 100 mm (4 inch) nominal thick may have electrical conduits 25 mm (1 inch) or less in diameter when covered with soaps, or other finishes.
  3. Fill recess chases after installation of conduit, with mortar and finish flush.
  4. When pipes or conduits, or both occur in hollow masonry unit partitions retain minimum one web of hollow masonry units.
- K. Wetting and Wetting Test:
1. Test and wet brick and clay tile according to BIA TN 11B.
  2. Do not wet concrete masonry units or glazed structural facing tile before laying.
- L. Temporary Formwork: Provide formwork and shores as required for temporary support of reinforced masonry elements.

- M. Construct formwork to conform to shape, line and dimensions indicated on drawings. Make sufficiently tight to prevent mortar, grout, or concrete leakage. Brace, tie and support formwork as required to maintain position and shape during construction and curing of reinforced masonry.
- N. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other reasonable temporary construction loads.

### **3.2 INSTALLATION - ANCHORAGE**

- A. Veneer to Framed Walls:
  - 1. Install adjustable veneer anchors.
  - 2. Fasten anchor to stud through sheathing with self-drilling and tapping screw, one at both ends of loop type anchor.
  - 3. Space anchors maximum 400 mm (16 inches) on center vertically at each stud.
- B. Masonry Facing to Backup and Cavity Wall Ties:
  - 1. Use individual ties for new work.
  - 2. Stagger ties in alternate courses, and space at 400 mm (16 inches) maximum vertically, and 400 mm (16 inches) horizontally.
  - 3. At openings, provide additional ties spaced maximum 900 mm (36 inches) apart vertically around perimeter of opening, and within 300 mm (12 inches) from edge of opening.
  - 4. Anchor new masonry facing to existing masonry with adjustable cavity wall ties spaced at 400 mm (16 inch) maximum vertical intervals and at every second masonry unit horizontally. Fasten ties to masonry with masonry nails.
  - 5. Option: Install joint reinforcing for multiple wythes and cavity wall ties spaced maximum 400 mm (16 inches) vertically.
  - 6. Tie interior and exterior wythes of reinforced masonry walls together with individual ties. Provide ties at intervals maximum 400 mm (16 inches) on center horizontally, and 400 mm (16 inches) on center vertically. Lay ties in the same line vertically in order to facilitate vibrating of the grout pours.
- C. Anchorage of Abutting Masonry:
  - 1. Anchor interior 100 mm (4 inch) thick masonry partitions to exterior masonry walls with wall ties. Space ties at 600 mm (24 inches) maximum vertical intervals. Extend ties 100 mm (4 inches) minimum into masonry.
  - 2. Anchor interior masonry bearing walls or interior masonry partitions over 100 mm (4 inches) thick to masonry walls with rigid wall anchors spaced at 400 mm (16 inch) maximum vertical intervals.
  - 3. Anchor abutting masonry walls and partitions to concrete with dovetail anchors. Install dovetail slots vertically in concrete at centerline of abutting wall or partition. Locate dovetail anchors at 400 mm (16 inch) maximum vertical intervals. Secure anchors to existing wall with two 9 mm (3/8 inch) by 75 mm (3 inch) expansion bolts or two power-driven fasteners.



4. Anchor abutting interior masonry partitions to existing concrete and existing masonry construction, with adjustable wall ties. Extend ties minimum 100 mm (4 inches) into joints of new masonry. Fasten ties to existing concrete and masonry construction, with powder actuated drive pins, nail or other means that provides rigid anchorage. Install anchors at 400 mm (16 inch) maximum vertical intervals.
- D. Anchorage to Steel Beams or Columns:
  1. Use adjustable beam anchors on each flange.
  2. At columns weld steel rod to steel columns at 300 mm (12 inch) intervals, and place wire ties in masonry courses at 400 mm (16 inches) maximum vertically.

### **3.3 INSTALLATION - REINFORCEMENT**

- A. Joint Reinforcement:
  1. Install joint reinforcement in CMU wythe of combination brick and CMU, cavity walls, and single wythe concrete masonry unit walls or partitions.
  2. Reinforcing is acceptable in lieu of individual ties for anchoring brick facing to CMU backup in exterior masonry walls.
  3. Locate joint reinforcement in mortar joints at 400 mm (16 inch) maximum vertical intervals.
  4. Additional joint reinforcement is required in mortar joints at both 200 mm (8 inches) and 400 (16 inches) above and below windows, doors, louvers and similar openings in masonry.
  5. Wherever brick masonry is backed up with stacked bond masonry, install multiple wythe joint reinforcement in every two courses of CMU backup, and in corresponding joint of facing brick.
- B. Steel Reinforcing Bars:
  1. Install reinforcing bars in cells of hollow masonry units where required for vertical reinforcement and in bond beam units for horizontal reinforcement. Install in wall cavities of reinforced masonry walls where indicated on drawings.
  2. Bond Beams:
    - a. Form Bond beams of load-bearing concrete masonry units filled with grout and reinforced with two No. 15m (No. 5) reinforcing bars unless shown otherwise. Do not cut reinforcement.
    - b. Brake bond beams only at expansion joints and at control joints, if shown.
  3. Stack Bond:
    - a. Locate additional joint reinforcement in vertical and horizontal joints as indicated on drawings.
    - b. Anchor vertical reinforcement into foundation or wall or bond beam below.
    - c. Provide temporary bracing for walls over 8 feet tall until permanent horizontal bracing is completed.
  4. Grout openings:

- a. Leave cleanout holes in double wythe walls during construction by omitting units at base of one side of wall.
- b. Locate 75 mm by 75 mm (3 inches. by 3 inches.) min. cleanout holes at location of vertical reinforcement.
- c. Keep grout space clean of mortar accumulation and debris. Clean as work progresses and immediately before grouting.

### **3.4 INSTALLATION - BRICK EXPANSION AND CMU CONTROL JOINTS**

- A. Provide brick expansion joint (EJ) and CMU control joints (CJ) where indicated on drawings.
- B. Keep joint free of mortar and other debris.
- C. Joints Occur In Masonry Walls:
  1. Install preformed compressible joint filler in brick wythe.
  2. Install cross shaped shear keys in concrete masonry unit wythe with preformed compressible joint filler on both sides of shear key.
- D. Use standard notched concrete masonry units (sash blocks) made in full and half-length units where shear keys are used to create a continuous vertical joint.
- E. Interrupt joint reinforcement at expansion and control joints.
- F. Fill opening in exposed face of expansion and control joints with sealant as specified in Section 07 92 00, JOINT SEALANTS.

### **3.5 INSTALLATION - BUILDING EXPANSION AND SEISMIC JOINTS**

- A. Keep expansion and seismic joints open and free of mortar. Remove mortar and other debris.
- B. Install non-combustible, compressible type joint filler to fill space completely except where sealant is shown on joints in exposed finish work.
- C. Fill opening in exposed face of expansion and seismic joints with sealant as specified in Section 07 92 00, JOINT SEALANTS.

### **3.6 INSTALLATION - ISOLATION JOINT**

- A. Where full height walls and partitions lie parallel or perpendicular to and under structural beams and shelf angles, provide minimum 9 mm (3/8 inch) separation between walls and partitions and bottom of beams and shelf angles.
- B. Insert continuous full width strip of non-combustible type compressible joint filler.
- C. Fill opening in exposed face of isolation joints with sealant as specified in Section 07 92 00, JOINT SEALANTS.

### **3.7 INSTALLATION - BRICKWORK**

- A. Lay clay brick according to BIA TN 11B.
- B. Laying:
  1. Lay brick in one-half running bond with bonded corners, unless indicated otherwise. Match bond of existing building on alterations and additions.

2. Maintain bond pattern throughout.
  3. Do not use brick smaller than half-brick at any angle, corner, break, and jamb.
  4. Where length of cut brick is greater than one half length, maintain vertical joint location.
  5. Lay exposed brickwork joints symmetrical about center lines of openings.
  6. Do not structurally bond multi-wythe brick walls, unless indicated on drawings.
  7. Before starting work, lay facing brick on foundation wall and adjust bond to openings, angles, and corners.
  8. Lay brick for sills with wash and drip.
  9. Build solid brickwork as required for anchorage of items.
- C. Joints:
1. Exterior and Interior Joint Widths: Lay for three equal joints in 200 mm (8 inches) vertically, unless shown otherwise.
  2. Rake joints for pointing with colored mortar when colored mortar is not full depth.
- D. Weep Holes:
1. Install weep holes at 600 mm (24 inches) on center in bottom of vertical joints of exterior masonry veneer or cavity wall facing over foundations, bond beams, and other water stops in wall.
  2. Form weep holes using wicks made of mineral fiber insulation strips turned up 200 mm (8 inches) in cavity. Anchor top of strip to backup to securely hold in place.
  3. Install sand or pea gravel in cavity approximately 75 mm (3 inches) high between weep holes.
- E. Solid Exterior Walls:
1. Build with 100 mm (4 inches) of nominal thick facing brick, backed up with concrete masonry units.
  2. Construct solid brick jambs minimum 20 mm (0.81 inches) wide at exterior wall openings and at recesses, except where exposed concrete unit backup is shown.
  3. Do not install full bonding headers.
  4. Parging:
    - a. For solid masonry walls, lay backup to height of six brick courses, parge backup with 13 mm (1/2 inch) of mortar troweled smooth; then lay exterior wythe to height of backup.
    - b. Make parging continuous over backup, and extend 150 mm (6 inches) onto adjacent concrete or masonry.
    - c. Parge ends and backs for recesses in exterior walls to thickness of 13 mm (1/2 inch).
    - d. Parge inside surface of exterior walls to produce true even surface to receive insulation.
- F. Cavity Walls:
1. Keep air space clean of mortar accumulations and debris.

2. Lay the interior wythe of the masonry wall full height where air barrier is required on cavity face. Coordinate to install air barrier before laying outer wythe.

### **3.8 INSTALLATION - CONCRETE MASONRY UNITS**

#### **A. Types and Uses:**

1. Provide special concrete masonry shapes as required, Provide solid concrete masonry units, where full units cannot be installed, or where needed for anchorage of accessories.
2. Provide solid load-bearing concrete masonry units or grout cell of hollow units at jambs of openings in walls, where structural members impose loads directly on concrete masonry, and where shown.
3. Do not install brick jambs in exposed finish work.
4. Install concrete building brick only as filler in backup material where not exposed.
5. Construct fire resistance in fire rated partitions meeting fire ratings indicated on drawings.

#### **B. Laying:**

1. Lay concrete masonry units with 9 mm (3/8 inch) joints, with a bond overlap of minimum 1/4 of unit length, except where stack bond is indicated on drawings.
2. Do not wet concrete masonry units before laying.
3. Bond external corners of partitions by overlapping alternate courses.
4. Lay first course in a full mortar bed.
5. Set anchorage items as work progress.
6. Where ends of anchors, bolts, and other embedded items, project into voids of units, completely fill voids with mortar or grout.
7. Provide 6 mm (1/4 inch) open joint for sealant between existing construction, exterior walls, and abutting masonry partitions.
8. Lay concrete masonry units with full face shell mortar beds and fill head joint beds for depth equivalent to face shell thickness.
9. Lay concrete masonry units so cores of units, that are to be filled with grout, are vertically continuous with joints of cross webs of such cores completely filled with mortar.  
Unobstructed core openings minimum 50 mm (2 inches) by 75 mm (3 inches).
10. Do not wedge masonry against steel reinforcing. Minimum 13 mm (1/2 inch) clear distance between reinforcing and masonry units.
11. Install deformed reinforcing bars of sizes indicated on drawings.
12. At time of placement, ensure steel reinforcement is free of loose rust, mud, oil, and other contamination capable of affecting bond.
13. Place steel reinforcement at spacing indicated on drawings before grouting.
14. Minimum clear distance between parallel bars: One bar diameter.
15. Hold vertical steel reinforcement in place vertically by centering clips, caging devices, tie wire, or other approved methods.

16. Support vertical bars near each end and at maximum 192 bar diameter on center.
17. Splice reinforcement or attach reinforcement to dowels by placing in contact and securing with wire ties.
18. Stagger splices in adjacent horizontal reinforcing bars. Lap reinforcing bars at splices a minimum of 40 bar diameters.
19. Grout cells of concrete masonry units, containing reinforcing bars, solid as specified.
20. Install cavity and joint reinforcement as masonry work progresses.
21. Rake joints 6 to 10 mm (1/4 to 3/8 inch) deep for pointing with colored mortar when colored mortar is not full depth.

### **3.9 Not Used**

### **3.10 POINTING**

- A. Fill joints with pointing mortar using rubber float trowel to apply mortar solidly into raked joints.
- B. Wipe off excess mortar from joints of glazed masonry units with dry cloth.
- C. Tool exposed joints to smooth concave joint.
- D. At joints with existing work, match existing joint.

### **3.11 GROUTING**

- A. Preparation:
  1. Clean grout space of mortar droppings before placing grout.
  2. Close cleanouts.
  3. Install vertical solid masonry dams across grout space for full height of wall at intervals of maximum 9000 mm (30 feet). Do not bond dam units into wythes as masonry headers.
  4. Verify reinforcing bars are installed as indicated on drawings.
- B. Placing:
  1. Place grout in grout space in lifts as specified.
  2. Consolidate each grout lift after free water has disappeared but before plasticity is lost.
  3. Do not slush with mortar or use mortar with grout.
  4. Interruptions:
    - a. When grouting must be stopped for more than an hour, top off grout 40 mm (1-1/2 inches) below top of last masonry course.
    - b. Grout from dam to dam on high lift method.
    - c. Longitudinal run of masonry may be stopped off only by raking back one-half masonry unit length in each course and stopping grout 100 mm (4 inches) back of rake on low lift method.
- C. Puddling Method:
  1. Consolidate by puddling with grout stick during and immediately after placing.

2. Grout cores of concrete masonry units containing reinforcing bars solid as masonry work progresses.
- D. Low Lift Method:
  1. Construct masonry to 1.5 m (5 feet) maximum height before grouting.
  2. Grout in one continuous operation and consolidate grout by mechanical vibration and reconsolidate after initial water loss and settlement has occurred.
- E. High Lift Method:
  1. Do not pour grout until masonry wall has cured minimum of 4 hours.
  2. Place grout in 1.5 m (5 feet) maximum lifts.
  3. Exception:
    - a. Where following conditions are met, place grout in 3.86 m (12.67 feet) maximum lifts.
    - b. Masonry has cured minimum of 4 hours.
    - c. Grout slump is maintained between 250 and 275 mm (10 and 11 inches).
    - d. No intermediate reinforced bond beams are placed between top and bottom of grout lift.
  4. When vibrating succeeding lifts, extend vibrator 300 to 450 mm (12 to 18 inches) into preceding lift.

### **3.12 PLACING REINFORCEMENT**

- A. General: Clean reinforcement of loose rust, mill scale, earth, ice or other materials which will reduce bond to mortar or grout. Do not use reinforcement bars with kinks or bends not shown on drawings or approved submittal drawings, or bars with reduced cross-section due to excessive rusting or other causes.
- B. Position reinforcement accurately at spacing indicated on drawings. Support and secure vertical bars against displacement. Install horizontal reinforcement as masonry work progresses. Where vertical bars are shown in close proximity, provide clear distance between bars of minimum one bar diameter or 25 mm (1 inch), whichever is greater.
- C. Splice reinforcement bars only where indicated on drawings, unless approved by Contracting Officer's Representative. Provide lapped splices. In splicing vertical bars or attaching to dowels, lap ends, place in contact and wire tie.
- D. Provide minimum lap as indicated on approved submittal drawings, or if not indicated, minimum 48 bar diameters.
- E. Embed metal ties in mortar joints as work progresses, with minimum mortar cover of 15 mm (5/8 inch) on exterior face of walls and 13 mm (1/2 inch) at other locations.
- F. Embed prefabricated horizontal joint reinforcement as work progresses, with minimum cover of 15 mm (5/8 inch) on exterior face of walls and 13 mm (1/2 inch) at other locations. Lap joint reinforcement minimum 150 mm (6 inches) at ends. Use prefabricated "L" and "T" sections to provide continuity at corners and intersections. Cut and bend joint reinforcement for continuity at returns, offsets, column fireproofing, pipe enclosures and other special conditions.

- G. Anchoring: Anchor reinforced masonry work to supporting structure as indicated on drawings.
- H. Anchor reinforced masonry walls at intersections with non-reinforced masonry.

**3.13 Not Used**

**3.14 Not Used**

**3.15 CONSTRUCTION TOLERANCES**

- A. Lay masonry units plumb, level and true to line within tolerances according to ACI 530.1/ASCE 6/TMS 602 and as follows:
- B. Maximum variation from plumb:
  - 1. In 3000 mm (10 feet) - 6 mm (1/4 inch).
  - 2. In 6000 mm (20 feet) - 9 mm (3/8 inch).
  - 3. In 12,000 mm (40 feet) or more - 13 mm (1/2 inch).
- C. Maximum variation from level:
  - 1. In any bay or up to 6000 mm (20 feet) - 6 mm (1/4 inch).
  - 2. In 12,000 mm (40 feet) or more - 13 mm (1/2 inch).
- D. Maximum variation from linear building lines:
  - 1. In any bay or up to 6000 mm (20 feet) - 13 mm (1/2 inch).
  - 2. In 12,000 mm (40 feet) or more - 19 mm (3/4 inch).
- E. Maximum variation in cross-sectional dimensions of columns and thickness of walls from dimensions shown:
  - 1. Minus 6 mm (1/4 inch).
  - 2. Plus 13 mm (1/2 inch).
- F. Maximum variation in prepared opening dimensions:
  - 1. Accurate to minus 0 mm (0 inch).
  - 2. Plus 6 mm (1/4 inch).

**3.16 CLEANING AND REPAIR**

- A. General:
  - 1. Clean exposed masonry surfaces on completion.
  - 2. Protect adjoining construction materials and landscaping during cleaning operations.
  - 3. Cut out defective exposed new joints to depth of approximately 19 mm (3/4 inch) and repoint.
  - 4. Remove mortar droppings and other foreign substances from wall surfaces.
- B. Brickwork:
  - 1. First wet surfaces with clean water, then wash down with detergent solution. Do not use muriatic acid.
  - 2. Brush with stiff fiber brushes while washing, and immediately wash with clean water.
  - 3. Remove traces of detergent, foreign streaks, or stains of any nature.

C. Concrete Masonry Units:

1. Immediately following setting, brush exposed surfaces free of mortar or other foreign matter.
2. Allow mud to dry before brushing.

-- E N D --



**SECTION 05 12 00**  
**STRUCTURAL STEEL FRAMING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Structural steel shapes, plates, and bars.
  - 2. Bolts, nuts, and washers.

**1.2 RELATED REQUIREMENTS**

- A. Materials Testing And Inspection During Construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Steel Decking: Section 05 31 00, STEEL DECKING.

**1.3 APPLICABLE PUBLICATIONS**

- A. Comply with references to extent specified in this section.
- B. American Institute of Steel Construction (AISC):
  - 1. AISC Manual - Steel Construction Manual, 14th Ed.
  - 2. 303-10 - Code of Structural Steel Buildings and Bridges.
  - 3. 360-10: Specification for Structural Steel Buildings.
- C. The American Society of Mechanical Engineers (ASME):
  - 1. B18.22.1-09 - Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers.
- D. American Welding Society (AWS):
  - 1. D1.1/D1.1M-15 - Structural Welding Code - Steel.
- E. ASTM International (ASTM):
  - 1. A6/A6M-14 - General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
  - 2. A36/A36M-14 - Carbon Structural Steel.
  - 3. A53/A53M-12 - Pipe, Steel, Black and Hot-Dip, Zinc-Coated, Welded and Seamless.
  - 4. A123/A123M-15 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - 5. A242/A242M-13 - High-Strength Low-Alloy Structural Steel.
  - 6. A283/A283M-13 - Low and Intermediate Tensile Strength Carbon Steel Plates.
  - 7. A307-14 - Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
  - 8. A325-14 - Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
  - 9. A490-14a - Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength.
  - 10. A500/A500M-13 - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing and Rounds and Shapes.
  - 11. A501/A501M-14 - Hot-Formed Welded and Seamless Carbon Steel Structural Tubing and Rounds and Shapes.

12. A572/A572M-15 - High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
  13. A992/A992M-15 - Structural Shapes.
  14. F2329/F2329M-15 - Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy steel Bolts, Screws, washers, Nuts, and Special Threaded Fasteners.
- F. Master Painters Institute (MPI):
1. No. 18 - Primer, Zinc Rich, Organic.
- G. Military Specifications (Mil. Spec.):
1. MIL-P-21035 - Paint, High Zinc Dust Content, Galvanizing, Repair.
- H. Occupational Safety and Health Administration (OSHA):
1. 29 CFR 1926.752(e) - Guidelines For Establishing The Components Of A Site-Specific Erection Plan.
  2. 29 CFR 1926-2001 - Safety Standards for Steel Erection.
- I. Research Council on Structural Connections (RCSC) of The Engineering Foundation:
1. Specification for Structural Joints Using ASTM A325 or A490 Bolts.

#### **1.4 SUBMITTALS**

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submittal Drawings:
1. Show size, configuration, and fabrication and installation details.
- C. Test Reports: Certify products comply with specifications.
1. Welders' qualifying tests.
- D. Certificates: Certify each product complies with specifications.
1. Structural steel.
  2. Steel connections.
  3. Welding materials.
  4. Shop coat primer paint.
- E. Qualifications: Substantiate qualifications comply with specifications.
1. Fabricator.
  2. Installer.
  3. Welders and welding procedures.
- F. Delegated Design Drawings and Calculations: Signed and sealed by responsible Architect/Engineer.
1. Connection calculations.

#### **1.5 QUALITY ASSURANCE**

- A. Fabricator Qualifications:
1. Regularly fabricates specified products.
  2. Fabricated specified products with satisfactory service on five similar installations for minimum five years.

- B. Installer Qualifications:
  - 1. Regularly installs specified products.
  - 2. Installed specified products with satisfactory service on five similar installations for minimum five years.
- C. Before commencement of Work, ensure steel erector provides written notification required by OSHA 29 CFR 1926.752(e). Submit a copy of the notification to Contracting Officer's Representative.
- D. Welders and Welding Procedures Qualifications: AWS D1.1/D1.1M.

## **1.6 WARRANTY**

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

## **PART 2 - PRODUCTS**

### **2.1 SYSTEM PERFORMANCE**

- A. Delegated Design: Prepare submittal documents including design calculations and drawings signed and sealed by registered design professional, licensed in state where project is located.
- B. Design structural steel framing connections complying with specified performance:
  - 1. Load Capacity: Resist full capacity of supported framing member. Account for connection and member loads and eccentricities.
    - a. Request additional design criteria when necessary to complete connection design.
  - 2. Configuration: Design and detail all connections for each member size, steel grade and connection type to resist the loads and reactions indicated on the drawings or specified herein. Use details consistent with details shown on drawings, supplementing where necessary. The details shown on drawings are conceptual and do not indicate the required weld sizes or number of bolts unless specifically noted. Use rational engineering design and standard practice in detailing, accounting for all loads and eccentricities in both the connection and the members. Promptly notify the Contracting Officer Representative of any location where the connection design criteria is not clearly indicated. The design of all connections is subject to the review and acceptance of the Contracting Officer's Representative. Submit structural calculations prepared and sealed by a qualified engineer registered in the state where the project is located. Submit calculations for review before preparation of detail drawings.

### **2.2 MATERIALS**

- A. W-Shapes:
  - 1. ASTM A992/A992M.
- B. Channel and Angles:
  - 1. ASTM A36/A36M.
- C. Plates and Bars:

1. ASTM A36/A36M.
- D. Hollow Structural Sections:
  1. ASTM A500/A500M.
- E. Bolts, Nuts and Washers:
  1. High-strength bolts, including nuts and washers: ASTM A325.
- F. Welding Materials: AWS D1.1, type to suit application.

## **2.3 PRODUCTS - GENERAL**

- A. Sustainable Construction Requirements:
  1. Steel Recycled Content: 30 percent total recycled content, minimum.

## **2.4 FABRICATION**

- A. Fabricate structural steel according to Chapter M, AISC 360.
- B. Shop and Field Connections:
  1. Weld connections according to AWS D1.1/D1.1M. Welds shall be made only by welders and welding operators who have been previously qualified by tests as prescribed in AWS D1.1 to perform type of work required.
  2. High-Strength Bolts: High-strength bolts tightened to a bolt tension minimum 70 percent of their minimum tensile strength. Tightening done with properly calibrated wrenches, by turn-of-nut method or by use of direct tension indicators (bolts or washers). Tighten bolts in connections identified as slip-critical using Direct Tension Indicators. Twist-off torque bolts are not an acceptable alternate fastener for slip critical connections.

## **2.5 FINISHES**

- A. Shop Priming:
  1. Prime paint structural steel according to AISC 303, Section 6.
- B. Do not paint:
  1. Surfaces within 50 mm (2 inches) of field welded joints.
  2. Surfaces indicated to be encased in concrete.
  3. Surfaces receiving sprayed on fireproofing.
  4. Beam top flanges receiving shear connector studs applied.
- C. Bolts, Nuts, and Washers Galvanizing: ASTM F2329, hot-dipped.

## **2.6 ACCESSORIES**

- A. General: Shop paint steel according to AISC 303, Section 6.
- B. Galvanizing Repair Paint: MPI No. 18.

## **PART 3 - EXECUTION**

### **3.1 ERECTION**

- A. Erect structural steel according to AISC 303 and AISC 360.

- B. Set structural steel accurately at locations and elevations indicated on drawings.
- C. Maintain erection tolerances of structural steel within AISC 303 requirements.
  - 1. Pour Stop Elevation Tolerance: 6 mm (1/4 inch), maximum, before concrete placement.
- D. Weld and bolt connections as specified for shop connections.

### **3.2 FIELD PAINTING**

- A. After welding, clean and prime weld areas to match adjacent finish.
- B. Touch-up primer damaged by construction operations.
- C. Apply galvanizing repair paint to galvanized coatings damaged by construction operations.

-- E N D --

**SECTION 05 31 00  
STEEL DECKING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Corrugated metal form deck supporting concrete fill.

**1.2 RELATED REQUIREMENTS**

- A. Structural Steel Shapes: Section 05 21 00, STRUCTURAL STEEL FRAMING.

**1.3 APPLICABLE PUBLICATIONS**

- A. Comply with references to extent specified in this section.
- B. AISI - American Iron and Steel Institute.
  - 1. S100-12 - Specification for the Design of Cold-formed Steel Structural Members.
- C. American Welding Society (AWS):
  - 1. D1.1/D1.1M-15 - Structural Welding Code - Steel.
  - 2. D1.3/D1.3M-08 - Structural Welding Code - Sheet Steel.
- D. ASTM International (ASTM):
  - 1. A36/A36M-14 - Carbon Structural Steel.
  - 2. A653/A653M-15 - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - 3. A1008/A1008M-15 - Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Baked Hardenable.
  - 4. C423-09a - Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
  - 5. E119-15 - Fire Tests of Building Construction and Materials.
- E. FM Global (FM):
  - 1. 1-28-15 - Wind Design.
  - 2. Factory Mutual Research Approval Guide.
- F. Master Painters Institute (MPI):
  - 1. No. 18 - Primer, Zinc Rich, Organic.
- G. Military Specifications (Mil. Spec.):
  - 1. MIL-P-21035B - Paint, High Zinc Dust Content, Galvanizing Repair.
- H. Steel Deck Institute (SDI):
  - 1. No. 31-07 - Design Manual for Composite Deck, Form Decks, and Roof Decks.
- I. UL LLC (UL):
  - 1. Listed - Online Certifications Directory.

2. 580-13 - Tests for Uplift Resistance of Roof Assemblies.

#### **1.4 SUBMITTALS**

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submittal Drawings:
  1. Show layout, connections to supporting members, anchorage, sump pans, accessories, deck openings and reinforcements.
  2. Show similar information necessary for completing installation as shown and specified, including supplementary framing, ridge and valley plates, cant strips, cut openings, special jointing or other accessories.
  3. Show welding, side lap, closure, deck reinforcing and closure reinforcing details.
  4. Show openings required for work of other trades, including openings not shown on structural drawings. Indicate where temporary shoring is required to satisfy design criteria.
- C. Manufacturer's Literature and Data:
  1. Description of each product.
  2. Show steel decking section properties and structural characteristics.
- D. Certificates: Certify each product complies with specifications.
  1. Fire Resistance Product Listing: For each metal deck type and thickness supporting concrete slab or fill.
  2. Show steel decking is UL Listed for specified application.
- E. Qualifications: Substantiate qualifications comply with specifications.
  1. Welders and welding procedures.

#### **1.5 QUALITY ASSURANCE**

- A. Welders and Welding Procedures Qualifications: AWS D1.3/D1.3M.

#### **1.6 WARRANTY**

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

### **PART 2 - PRODUCTS**

#### **2.1 SYSTEM PERFORMANCE**

- A. Design steel decking and accessories according to AISI S100.

#### **2.2 MATERIALS**

- A. Galvanized Steel Sheet: ASTM A653/A653M; G60 coating.
- B. Steel Shapes: ASTM A36/A36M.

#### **2.3 Not used**

#### **2.4 METAL ROOF DECK**

- A. Metal Roof Deck: UL Listed as metal roof deck panels.

1. Steel decking of the type, depth, thickness, and section properties as shown.
- B. Metal Form Deck - Type 1: Single pan fluted units as permanent form for reinforced concrete slabs.
  1. Depth and Thickness: As indicated on drawings.
  2. Material: Galvanized sheet steel.
  3. Deck Style: As indicated on drawings
  4. Depth and Thickness: As indicated on drawings.
  5. Material: Galvanized sheet steel.
- C. Do not use steel deck for hanging supports of building components including suspended ceilings, electrical light fixtures, plumbing, heating, or air conditioning pipes or ducts or electrical conduits.

## **2.5 FABRICATION**

- A. Fabricate steel decking in sufficient lengths to extend over 3 or more supports, unless noted otherwise.
  1. Cut metal deck units to proper length in shop.
- B. Fabricate accessories required to complete installation of steel decking.
  1. Concealed from View: Fabricate from galvanized sheet steel.
- C. Sheet Metal Accessories:
  1. Metal Cover Plates: For end-abutting decking, to close gaps at changes in deck direction, columns, walls and openings.
    - a. Sheet Steel: Minimum 1.0 mm (0.04 inch) thick.
  2. Continuous Sheet Metal Edging: At openings, concrete slab edges and roof deck edges.
    - a. Sheet Steel: Minimum 1.0 mm (0.04 inch) thick.
  3. Metal Closure Strips: For openings between decking and other construction. Form to configurations required to provide tight-fitting closures at open ends of flutes and sides of decking.
    - a. Sheet Steel: Minimum 1.0 mm (0.04 inch) thick.
  4. Ridge and Valley Plates: Minimum 100 mm (4 inch) wide ridge and valley plates where roof slope exceeds 1/24 (1/2 inch per foot).
    - a. Sheet Steel: Minimum 1.0 mm (0.04 inch) thick.
  5. Cant Strips: Provide bent metal 45 degree leg cant strips where indicated on the drawings. Fabricate cant strips with minimum 125 mm (5 inch) face width.
    - a. Sheet Steel: Minimum 0.8 mm (0.03 inch) thick.
  6. Seat Angles for Deck: Provide where beam does not frame into column.
  7. Sump Pans for Roof Drains: Fabricated from single piece galvanized sheet steel with level bottoms and sloping sides to direct water flow to drain. Provide sump pans of adequate size to receive roof drains and with bearing flanges minimum 75 mm (3 inches) wide. Recess



pans minimum 38 mm (1-1/2 inches) below roof deck surface, unless otherwise shown or required by deck configuration. Drain holes will be field cut.

- a. Sheet Steel: Minimum 1.7 mm (0.06 inch) thick.

## **2.6 FINISHES**

- A. Galvanized.

## **2.7 ACCESSORIES**

- A. Welding Materials: AWS D1.1, type to suit application.
- B. Galvanizing Repair Paint: MPI No. 18.

# **PART 3 - EXECUTION**

## **3.1 PREPARATION**

- A. Examine and verify substrate suitability for product installation.
- B. Protect existing construction and completed work from damage.
- C. Remove contaminants from structural steel surfaces where steel decking will be welded.
- D. Verify structural steel framing installation is completed, plumbed, and aligned with temporary bracing installed where required.
- E. Coordinate with structural steel erector to prevent overloading of structural members when placing steel decking for installation.

## **3.2 ERECTION**

- A. Do not use floor deck units for storage or working platforms until permanently secured. Do not overload deck units once placed. Replace deck units that become damaged after erection and before casting concrete at no cost additional to the Government.
- B. Place steel decking at right angles to supporting members with ends located over supports.
- C. Lap end joints 50 mm (2 inches), minimum.
- D. Corrugated Form Deck Fastening: as shown on drawings
- E. Roof Deck Fastening: as shown on drawings
- F. Cutting and Fitting:
  1. Field cut steel decking to accommodate columns and other penetrating items.
  2. Cut openings located and dimensioned on Structural Drawings.
  3. Coordinate openings for other penetrations shown on approved submittal drawings but not shown on Structural Drawings.
    - a. Cut and reinforce required opening.
  4. Make cuts neat and trim using metal saw, drill or punch-out device. Cutting with torches is prohibited.
  5. Do not make cuts in the metal deck that are not shown on the approved metal decking submittal drawings.

- a. When additional openings are required, submit scaled drawing, locating required opening and other openings and supports in immediate area.
  - b. Do not cut the opening until drawing is approved by Contracting Officer's Representative.
  - c. Provide additional reinforcing and framing required for opening.
  - d. Failure to comply with these requirements is cause for rejection of the work and removal and replacement of the affected steel decking.
6. Opening Reinforcement: Provide additional metal reinforcement and closure pieces as required for strength, continuity of decking, and support of other work.
- G. Touch up damaged factory finishes.
1. Apply galvanizing repair paint to damaged galvanized surfaces.
  2. Apply touch up paint to damaged shop painted surfaces.

- - E N D - -

**SECTION 05 40 00  
COLD-FORMED METAL FRAMING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

- A. This section specifies materials and services required for installation of cold-formed steel, including tracks and required accessories as shown and specified. This Section includes the following:

1. Exterior load-bearing steel stud walls.
2. Steel trusses.

**1.2 RELATED WORK:**

- A. Structural steel framing: Section 05 12 00, STRUCTURAL STEEL FRAMING.
- B. Non-load-bearing metal stud framing assemblies: Section 09 22 16, NON-STRUCTURAL METAL FRAMING.
- C. Gypsum board assemblies: Section 09 29 00, GYPSUM BOARD.

**1.3 DESIGN REQUIREMENTS:**

- A. Design steel in accordance with American Iron and Steel Institute Publication "Specification for the Design of Cold-Formed Steel Structural Members", except as otherwise shown or specified.
- B. Structural Performance: fabricate and erect cold-formed metal framing with the minimum physical and structural properties indicated.
- C. Structural Performance (roof trusses): Engineer, fabricate, and erect cold-formed metal framing to withstand design loads within limits and under conditions required.
1. Design Loads: As indicated on drawings.
  2. Design framing systems to withstand design loads without deflections greater than the following:
    - e. Roof Trusses: Vertical deflection of 1/240 of the span.
  3. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change (range) of 67 degrees C (120 degrees F).
  4. Design framing system to accommodate deflection of primary building structure and construction tolerances, and to maintain clearances at openings.

5. 6. Engineering Responsibility: Engage a fabricator who assumes undivided responsibility for engineering cold-formed metal framing by employing a qualified professional engineer to prepare design calculations, shop drawings, and other structural data.

**1.4 SUBMITTALS:**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings: Shop and erection drawings showing steel unit layout, connections to supporting members, and information necessary to complete installation as shown and specified.
- C. Manufacturer's Literature and Data: Showing steel component sections and specifying structural characteristics.
- D. For cold-formed metal framing indicated to comply with certain design loadings, include structural analysis data sealed and signed by the qualified professional engineer who was responsible for its preparation.

**1.5 APPLICABLE PUBLICATIONS:**

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Iron and Steel Institute (AISI):  
Specification and Commentary for the Design of Cold-Formed Steel Structural Members (1996)
- C. American Society of Testing and Materials (ASTM):  
A36/A36M-08 ..... Standard Specifications for Carbon Structural Steel  
A123/A123M-09 ..... Standard Specifications for Zinc (Hot-Dip Galvanized) Coatings  
on Iron and Steel Products  
A153/A153M-09 ..... Standard Specifications for Zinc Coating (Hot-Dip) on Iron and  
Steel Hardware  
A307-10..... Standard Specifications for Carbon Steel Bolts and Studs  
A653/A653M-10 ..... Standard Specifications for Steel Sheet, Zinc-Coated  
(Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the  
Hot-Dip Process  
C955..... Standard Specification for Load-Bearing (Transverse and Axial)  
Steel Studs, Runners (Tracks), and Bracing or Bridging for  
Screw Application of Gypsum Panel Products and Metal Plaster  
Bases

C1107/C1107M-08.....Standard Specifications for Packaged Dry, Hydraulic-Cement  
Grout (Non-shrink)

E488-96(R2003).....Standard Test Methods for Strength of Anchors in Concrete and  
Masonry Elements

E1190-95(R2007).....Standard Test Methods for Strength of Power-Actuated  
Fasteners Installed in Structural Members

D. American Welding Society (AWS):

D1.3/D1.3M-08.....Structural Welding Code-Sheet Steel

E. Military Specifications (Mil. Spec.):

MIL-P-21035B .....Paint, High Zinc Dust Content, Galvanizing Repair

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS:**

- A. Sheet Steel for joists, studs and accessories 16 gage and heavier: ASTM A653, structural steel, zinc coated G90, with a yield of 340 MPa (50 ksi) minimum.
- B. Sheet Steel for joists, studs and accessories 18 gage and lighter: ASTM A653, structural steel, zinc coated G90, with a yield of 230 MPa (33 ksi) minimum.
- C. Galvanizing Repair Paint: MIL-P-21035B.

### **2.2 WALL FRAMING:**

- A. Steel Studs: Complying with ASTM C 955. Manufacturer's standard C-shaped steel studs of web depth indicated, with lipped flanges, as shown on drawings.
  - 1. Web: Punched.
- B. Steel Track: Manufacturer's standard U-shaped steel track, unpunched, of web depths indicated, with straight flanges, and complying with the following:
  - 1. Design Uncoated-Steel Thickness: Matching steel studs.
  - 2. Flange Width: Manufacturer's standard deep flange where indicated, standard flange elsewhere.

### **2.3 NOT USED**

### **2.4 FRAMING ACCESSORIES:**

- A. Fabricate steel framing accessories of the same material and finish used for framing members, with a minimum yield strength of 230 MPa (33 ksi).

- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
1. Supplementary framing.
  2. Bracing, bridging, and solid blocking.
  3. Web stiffeners.
  4. Gusset plates.
  5. Deflection track and vertical slide clips.
  6. Stud kickers and girts.
  7. Joist hangers and end closures.
  8. Reinforcement plates.

## **2.5 ANCHORS, CLIPS, AND FASTENERS:**

- A. Steel Shapes and Clips: ASTM A36, zinc coated by the hot-dip process according to ASTM A123.
- B. Cast-in-Place Anchor Bolts and Studs: ASTM A307, Grade A, zinc coated by the hot-dip process according to ASTM A153.
- C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times the design load, as determined by testing per ASTM E488 conducted by a qualified independent testing agency.
- D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times the design load, as determined by testing per ASTM E1190 conducted by a qualified independent testing agency.
- E. Mechanical Fasteners: Corrosion-resistant coated, self-drilling, self-threading steel drill screws. Low-profile head beneath sheathing, manufacturer's standard elsewhere.

## **2.6 REQUIREMENTS:**

- A. Welding in accordance with AWS D1.3
- B. Furnish members and accessories by one manufacturer only.

## **PART 3 - EXECUTION**

### **3.1 FABRICATION:**

- A. Framing components may be preassembled into panels. Panels shall be square with components attached.

- B. Cut framing components squarely or as required for attachment. Cut framing members by sawing or shearing; do not torch cut.
- C. Hold members in place until fastened.
- D. Fasten cold-formed metal framing members by welding or screw fastening, as standard with fabricator. Wire tying of framing members is not permitted.
  - 1. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
  - 2. Locate mechanical fasteners and install according to cold-formed metal framing manufacturer's instructions with screw penetrating joined members by not less than 3 exposed screw threads.
- E. Where required, provide specified insulation in double header members and double jamb studs which will not be accessible after erection.

### **3.2 ERECTION:**

- A. Handle and lift prefabricated panels in a manner as to not distort any member.
- B. Securely anchor tracks to supports as shown.
- C. At butt joints, securely anchor two pieces of track to same supporting member or butt-weld or splice together.
- D. Plumb, align, and securely attach studs to flanges or webs of both upper and lower tracks.
- E. All axially loaded members shall be aligned vertically to allow for full transfer of the loads down to the foundation. Vertical alignment shall be maintained at floor/wall intersections.
- F. Install jack studs above and below openings and as required to furnish support. Securely attach jack studs to supporting members.
- G. Install headers in all openings that are larger than the stud spacing in that wall.
- H. Attach bridging for studs in a manner to prevent stud rotation. Space bridging rows as shown.
- I. Studs in one piece for their entire length, splices will not be permitted.
- J. Provide a load distribution member at top track where joist is not located directly over bearing stud.
- K. Provide joist bridging and web stiffeners at reaction points where shown.
- L. Provide end blocking where joist ends are not restrained from rotation.

- M. Provide an additional joist under parallel partitions, unless otherwise shown, when partition length exceeds one-half joist span and when floor and roof openings interrupt one or more spanning members.
- N. Provide temporary bracing and leave in place until framing is permanently stabilized.
- O. Do not bridge building expansion joints with cold-formed metal framing. Independently frame both sides of joints.
- P. Fasten reinforcement plate over web penetrations that exceed size of manufacturer's standard punched openings.

**3.3 TOLERANCES:**

- A. Vertical alignment (plumbness) of studs shall be within 1/960th of the span.
- B. Horizontal alignment (levelness) of walls shall be within 1/960th of their respective lengths.
- C. Spacing of studs shall not be more than 3 mm (1/8 inch) +/- from the designed spacing providing that the cumulative error does not exceed the requirements of the finishing materials.
- D. Prefabricated panels shall be not more than 3 mm (1/8 inch) +/- out of square within the length of that panel.

**3.4 FIELD REPAIR:**

Touch-up damaged galvanizing with galvanizing repair paint.

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**SECTION 05 50 00  
METAL FABRICATIONS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies items and assemblies fabricated from structural steel shapes and other materials as shown and specified.
- B. Items specified.
  - 1. Loose Lintels
  - 2. Shelf Angles
  - 3. Steel Pipe Bollards
  - 4. Floor plate

**1.2 RELATED WORK**

- A. Railings attached to steel stairs: Section 05 51 00, METAL STAIRS.
- B. Prime and finish painting: Section 09 91 00, PAINTING.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
  - 1. Floor Plate
- C. Shop Drawings:
  - 1. Each item specified, showing complete detail, location in the project, material and size of components, method of joining various components and assemblies, finish, and location, size and type of anchors.
  - 2. Mark items requiring field assembly for erection identification and furnish erection drawings and instructions.
  - 3. Provide templates and rough-in measurements as required.
- D. Not Used
- E. Furnish setting drawings and instructions for installation of anchors to be preset into concrete and masonry work, and for the positioning of items having anchors to be built into concrete or masonry construction.

**1.4 QUALITY ASSURANCE**

- A. Each manufactured product shall meet, as a minimum, the requirements specified, and shall be a standard commercial product of a manufacturer regularly presently manufacturing items of type specified.
- B. Each product type shall be the same and be made by the same manufacturer.
- C. Assembled product to the greatest extent possible before delivery to the site.

- D. Include additional features, which are not specifically prohibited by this specification, but which are a part of the manufacturer's standard commercial product.

### 1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Mechanical Engineers (ASME):
- B18.6.1-97..... Wood Screws
  - B18.2.2-87(R2005)..... Square and Hex Nuts
- C. American Society for Testing and Materials (ASTM):
- A36/A36M-12 ..... Structural Steel
  - A47-99(R2009)..... Malleable Iron Castings
  - A48-03(R2012)..... Gray Iron Castings
  - A53-12..... Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
  - A123-12..... Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
  - A240/A240M-14 ..... Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications.
  - A269-10..... Seamless and Welded Austenitic Stainless Steel Tubing for General Service
  - A307-12..... Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
  - A391/A391M-07(R2012) ..... Grade 80 Alloy Steel Chain
  - A786/A786M-09 ..... Rolled Steel Floor Plate
  - B221-13..... Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
  - B456-11 ..... Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium
  - B632-08..... Aluminum-Alloy Rolled Tread Plate
  - C1107-13 ..... Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
  - D3656-13 ..... Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns
  - F436-11 ..... Hardened Steel Washers
  - F468-06(R2012) ..... Nonferrous Bolts, Hex Cap Screws, Socket Head Cap Screws and Studs for General Use
  - F593-13..... Stainless Steel Bolts, Hex Cap Screws, and Studs
  - F1667-11 ..... Driven Fasteners: Nails, Spikes and Staples

- D. American Welding Society (AWS):
  - D1.1-10 ..... Structural Welding Code Steel
  - D1.2-08 ..... Structural Welding Code Aluminum
  - D1.3-08 ..... Structural Welding Code Sheet Steel
- E. National Association of Architectural Metal Manufacturers (NAAMM)
  - AMP 521-01 ..... Pipe Railing Manual
  - AMP 500-06 ..... Metal Finishes Manual
  - MBG 531-09..... Metal Bar Grating Manual
  - MBG 532-09..... Heavy Duty Metal Bar Grating Manual
- F. Structural Steel Painting Council (SSPC)/Society of Protective Coatings:
  - SP 1-04 ..... No. 1, Solvent Cleaning
  - SP 2-04 ..... No. 2, Hand Tool Cleaning
  - SP 3-04 ..... No. 3, Power Tool Cleaning
- G. Federal Specifications (Fed. Spec):
  - RR-T-650E ..... Treads, Metallic and Nonmetallic, Nonskid

## **PART 2 - PRODUCTS**

### **2.1 DESIGN CRITERIA**

- A. In addition to the dead loads, design fabrications to support the following live loads unless otherwise specified.
- B. Railings and Handrails: 900 N (200 pounds) in any direction at any point.

### **2.2 MATERIALS**

- A. Structural Steel: ASTM A36.
- B. Stainless Steel: ASTM A240, Type 302 or 304.
- C. Floor Plate:
  - 1. Steel ASTM A786.
  - 2. Aluminum: ASTM B632.
- E. Steel Pipe (Bollard): ASTM A53.
  - 1. Galvanized for exterior locations.
  - 2. Type S, Grade A unless specified otherwise.
  - 3. NPS (inside diameter) as shown.
- F. Primer Paint: As specified in Section 09 91 00, PAINTING.
- G. Grout: ASTM C1107, pourable type.

### **2.3 HARDWARE**

- A. Rough Hardware:
  - 1. Furnish rough hardware with a standard plating, applied after punching, forming and assembly of parts; galvanized, cadmium plated, or zinc-coated by electro-galvanizing process. Galvanized G-90 where specified.

2. Use G90 galvanized coating on ferrous metal for exterior work unless non-ferrous metal or stainless is used.

B. Fasteners:

1. Bolts with Nuts:
  - a. ASME B18.2.2.
  - b. ASTM A307 for 415 MPa (60,000 psi) tensile strength bolts.
  - c. ASTM F468 for nonferrous bolts.
  - d. ASTM F593 for stainless steel.
2. Screws: ASME B18.6.1.
3. Washers: ASTM F436, type to suit material and anchorage.
4. Nails: ASTM F1667, Type I, style 6 or 14 for finish work.

## 2.4 FABRICATION GENERAL

A. Material

1. Use material as specified. Use material of commercial quality and suitable for intended purpose for material that is not named or its standard of quality not specified.
2. Use material free of defects which could affect the appearance or service ability of the finished product.

B. Size:

1. Size and thickness of members as shown.
2. When size and thickness is not specified or shown for an individual part, use size and thickness not less than that used for the same component on similar standard commercial items or in accordance with established shop methods.

C. Connections

1. Except as otherwise specified, connections may be made by welding, riveting or bolting.
2. Field riveting will not be approved.
3. Design size, number and placement of fasteners, to develop a joint strength of not less than the design value.
4. Holes, for rivets and bolts: Accurately punched or drilled and burrs removed.
5. Size and shape welds to develop the full design strength of the parts connected by welds and to transmit imposed stresses without permanent deformation or failure when subject to service loadings.
6. Use Rivets and bolts of material selected to prevent corrosion (electrolysis) at bimetallic contacts. Plated or coated material will not be approved.
7. Use stainless steel connectors for removable members machine screws or bolts.

D. Fasteners and Anchors

1. Use methods for fastening or anchoring metal fabrications to building construction as shown or specified.

2. Where fasteners and anchors are not shown, design the type, size, location and spacing to resist the loads imposed without deformation of the members or causing failure of the anchor or fastener, and suit the sequence of installation.
3. Use material and finish of the fasteners compatible with the kinds of materials which are fastened together and their location in the finished work.
4. Fasteners for securing metal fabrications to new construction only, may be by use of threaded or wedge type inserts or by anchors for welding to the metal fabrication for installation before the concrete is placed or as masonry is laid.
5. Fasteners for securing metal fabrication to existing construction or new construction may be expansion bolts, toggle bolts, power actuated drive pins, welding, self drilling and tapping screws or bolts.

E. Workmanship

1. General:
  - a. Fabricate items to design shown.
  - b. Furnish members in longest lengths commercially available within the limits shown and specified.
  - c. Fabricate straight, true, free from warp and twist, and where applicable square and in same plane.
  - d. Provide holes, sinkages and reinforcement shown and required for fasteners and anchorage items.
  - e. Provide openings, cut-outs, and tapped holes for attachment and clearances required for work of other trades.
  - f. Prepare members for the installation and fitting of hardware.
  - g. Cut openings in gratings and floor plates for the passage of ducts, sumps, pipes, conduits and similar items. Provide reinforcement to support cut edges.
  - h. Fabricate surfaces and edges free from sharp edges, burrs and projections which may cause injury.
2. Welding:
  - a. Weld in accordance with AWS.
  - b. Welds shall show good fusion, be free from cracks and porosity and accomplish secure and rigid joints in proper alignment.
  - c. Where exposed in the finished work, continuous weld for the full length of the members joined and have depressed areas filled and protruding welds finished smooth and flush with adjacent surfaces.
  - d. Finish welded joints to match finish of adjacent surface.
3. Joining:
  - a. Miter or butt members at corners.

- b. Where frames members are butted at corners, cut leg of frame member perpendicular to surface, as required for clearance.
- 4. Anchors:
  - a. Where metal fabrications are shown to be preset in concrete, weld 32 x 3 mm (1-1/4 by 1/8 inch) steel strap anchors, 150 mm (6 inches) long with 25 mm (one inch) hooked end, to back of member at 600 mm (2 feet) on center, unless otherwise shown.
  - b. Where metal fabrications are shown to be built into masonry use 32 x 3 mm (1-1/4 by 1/8 inch) steel strap anchors, 250 mm (10 inches) long with 50 mm (2 inch) hooked end, welded to back of member at 600 mm (2 feet) on center, unless otherwise shown.
- 5. Cutting and Fitting:
  - a. Accurately cut, machine and fit joints, corners, copes, and miters.
  - b. Fit removable members to be easily removed.
  - c. Design and construct field connections in the most practical place for appearance and ease of installation.
  - d. Fit pieces together as required.
  - e. Fabricate connections for ease of assembly and disassembly without use of special tools.
  - f. Joints firm when assembled.
  - g. Conceal joining, fitting and welding on exposed work as far as practical.
  - h. Do not show rivets and screws prominently on the exposed face.
  - i. The fit of components and the alignment of holes shall eliminate the need to modify component or to use exceptional force in the assembly of item and eliminate the need to use other than common tools.
- F. Finish:
  - 1. Finish exposed surfaces in accordance with NAAMM AMP 500 Metal Finishes Manual.
  - 2. Steel and Iron: NAAMM AMP 504.
    - a. Zinc coated (Galvanized): ASTM A123, G90 unless noted otherwise.
    - b. Surfaces exposed in the finished work:
      - 1) Finish smooth rough surfaces and remove projections.
      - 2) Fill holes, dents and similar voids and depressions with epoxy type patching compound.
    - c. Shop Prime Painting:
      - 1) Surfaces of Ferrous metal:
        - a) Items not specified to have other coatings.
        - b) Galvanized surfaces specified to have prime paint.
        - c) Remove all loose mill scale, rust, and paint, by hand or power tool cleaning as defined in SSPC-SP2 and SP3.

- d) Clean of oil, grease, soil and other detrimental matter by use of solvents or cleaning compounds as defined in SSPC-SP1.
- e) After cleaning and finishing apply one coat of primer as specified in Section 09 91 00, PAINTING.

2) Non ferrous metals: Comply with MAAMM-500 series.

G. Protection:

- 1. Insulate aluminum surfaces that will come in contact with concrete, masonry, plaster, or metals other than stainless steel, zinc or white bronze by giving a coat of heavy-bodied alkali resisting bituminous paint or other approved paint in shop.
- 2. Spot prime all abraded and damaged areas of zinc coating which expose the bare metal, using zinc rich paint on hot-dip zinc coat items and zinc dust primer on all other zinc coated items.

## 2.5 SUPPORTS

A. General:

- 1. Fabricate ASTM A36 structural steel shapes as shown.
- 2. Use clip angles or make provisions for welding hangers and braces to overhead construction.
- 3. Field connections may be welded or bolted.

## 2.6 NOT USED

## 2.8 STEEL PLATE

A. Fabricate covers to support 60 psf live loads.

B. Galvanized steel members after fabrication in accordance with ASTM A123, G-90 coating.

C. Steel Covers:

- 1. Use 6 mm (1/4 inch) thick floor plate for covers unless otherwise shown. Use gratings where shown as specified in paragraph GRATINGS. Use checkered floor plate unless noted otherwise.
- 2. Provide clearance at all sides to permit easy removal of covers.
- 3. Make cutouts within 6 mm (1/4 inch) of penetration for passage of pipes and ducts.
- 4. Drill covers for flat head countersunk screws.
- 5. Make cover sections not to exceed 2.3 m<sup>2</sup> (25 square feet) in area and 90 kg (200 pounds) in weight.
- 6. Provide angle supports as needed during galvanizing process to avoid warping.

## 2.10 LOOSE LINTELS

- A. Furnish lintels of sizes shown. Where size of lintels is not shown, provide the sizes specified.
- B. Fabricate lintels with not less than 150 mm (6 inch) bearing at each end for nonbearing masonry walls, and 200 mm (8 inch) bearing at each end for bearing walls.

- C. Provide one angle lintel for each 100 mm (4 inches) of masonry thickness as follows except as otherwise specified or shown.
  - 1. Openings 750 mm to 1800 mm (2-1/2 feet to 6 feet) - 100 x 90 x 8 mm (4 x 3-1/2 x 5/16 inch).
  - 2. Openings 1800 mm to 3000 mm (6 feet to 10 feet) - 150 x 90 x 9 mm (6 x 3-1/2 x 3/8 inch).
- D. For 150 mm (6 inch) thick masonry openings 750 mm to 3000 mm (2-1/2 feet to 10 feet) use one angle 150 x 90 x 9 mm (6 x 3-1/2 x 3/8 inch).
- E. Provide bearing plates for lintels where shown.
- F. Weld or bolt upstanding legs of double angle lintels together with 19 mm (3/4 inch bolts) spaced at 300 mm (12 inches) on centers.
- G. Insert spreaders at bolt points to separate the angles for insertion of metal windows, louver, and other anchorage.
- H. Where shown or specified, punch upstanding legs of single lintels to suit size and spacing of anchor bolts.

## **2.11 SHELF ANGLES**

- A. Fabricate from steel angles of size shown.
- B. Fabricate angles with horizontal slotted holes for 19 mm (3/4 inch) bolts spaced at not over 900 mm (3 feet) on centers and within 300 mm (12 inches) of ends.
- C. Provide adjustable malleable iron inserts for embedded in concrete framing.

## **2.12 STEEL PIPE BOLLARD**

Provide bollard in accordance with ASTM A53 with dimensions as shown on drawings. Anchor posts in concrete.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION, GENERAL**

- A. Set work accurately, in alignment and where shown, plumb, level, free of rack and twist, and set parallel or perpendicular as required to line and plane of surface.
- B. Items set into concrete or masonry.
  - 1. Provide temporary bracing for such items until concrete or masonry is set.
  - 2. Place in accordance with setting drawings and instructions.
  - 3. Build strap anchors, into masonry as work progresses.
- C. Set frames of gratings, covers, corner guards, trap doors and similar items flush with finish floor or wall surface and, where applicable, flush with side of opening.
- D. Field weld in accordance with AWS.
  - 1. Design and finish as specified for shop welding.
  - 2. Use continuous weld unless specified otherwise.



- E. Install anchoring devices and fasteners as shown and as necessary for securing metal fabrications to building construction as specified. Power actuated drive pins may be used except for removable items and where members would be deformed or substrate damaged by their use.
- F. Spot prime all abraded and damaged areas of zinc coating as specified and all abraded and damaged areas of shop prime coat with same kind of paint used for shop priming.
- G. Isolate aluminum from dissimilar metals and from contact with concrete and masonry materials as required to prevent electrolysis and corrosion.
- H. Secure escutcheon plate with set screw.

### **3.2 INSTALLATION OF SUPPORTS**

- A. Anchorage to structure.
  - 1. Secure angles or channels and clips to overhead structural steel by continuous welding unless bolting is shown.
  - 2. Secure supports to concrete inserts by bolting or continuous welding as shown.
  - 3. Secure supports to mid height of concrete beams when inserts do not exist with expansion bolts and to slabs, with expansion bolts. unless shown otherwise.
  - 4. Secure steel plate or hat channels to studs as detailed.

### **3.3 PLATES**

- A. Set frame and cover flush with finish floor.
- B. Secure plates to frame with flat head countersunk screws.

### **3.9 STEEL LINTELS**

- A. Use lintel sizes and combinations shown or specified.
- B. Install lintels with longest leg upstanding, except for openings in 150 mm (6 inch) masonry walls install lintels with longest leg horizontal.
- C. Install lintels to have not less than 150 mm (6 inch) bearing at each end for nonbearing walls, and 200 mm (8 inch) bearing at each end for bearing walls.

### **3.10 SHELF ANGLES**

- A. Anchor shelf angles with 19 mm (3/4 inch) bolts unless shown otherwise in adjustable malleable iron inserts, set level at elevation shown.
- B. Provide expansion space at end of members.

### **3.19 INSTALLATION OF STEEL PIPE BOLLARD**

Set bollards vertically in concrete piers as shown on drawings.

### **3.20 CLEAN AND ADJUSTING**

- A. Adjust movable parts including hardware to operate as designed without binding or deformation of the members centered in the opening or frame and, where applicable, contact surfaces fit tight and even without forcing or warping the components.

- B. Clean after installation exposed prefinished and plated items and items fabricated from stainless steel, aluminum and copper alloys, as recommended by the metal manufacture and protected from damage until completion of the project.

--- E N D ---

**SECTION 05 51 00  
METAL STAIRS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

- A. This section specifies steel stairs with railings.
- B. Types:
  - 1. Industrial stairs: closed riser stairs.

**1.2 RELATED WORK:**

- C. Wall handrails and railings for other than steel stairs: Section 05 50 00, METAL FABRICATIONS.

**1.3 SUBMITTALS:**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings: Show design, fabrication details, installation, connections, material, and size of members.
- D. Fabrication qualifications.
- E. Installer qualifications.
- F. Welding qualifications.

**1.4 QUALITY ASSURANCE:**

- A. Fabricator: A firm with a minimum of three (3) years' experience in type of work required by this section. Submit fabricator qualifications.
- B. Installer: A firm with a minimum of three (3) years' experience in type of work required by this section. Submit installer qualifications.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M and AWS D1.3/D1.3M.

**1.5 APPLICATION PUBLICATIONS:**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation.
- B. American Society of Mechanical Engineers (ASME):
  - B18.2.1-12.....Square, Hex, Heavy Hex, and Askew Head Bolts and Hex,  
Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch  
Series)
  - B18.2.3.8M-81(R2005).....Metric Heavy Lag Screws
  - B18.6.1-81(R2008).....Wood Screws (Inch Series)
  - B18.6.3-13.....Machine Screws, Tapping Screws, and Metallic Drive Screws  
(Inch Series)
  - B18.6.5M-10.....Metric Thread Forming and Thread Cutting Tapping Screws
  - B18.6.7M-10.....Metric Machine Screws

- B18.22M-81(R2010).....Metric Plain Washers
- B18.21.1-09.....Washers: Helical Spring-Lock, Tooth Lock, and Plain Washer  
(Inch Series)
- B. ASTM International (ASTM):
- A36/A36M-14 .....Structural Steel
- A47/A47M-99 (R2014) .....Ferritic Malleable Iron Castings
- A48/A48M-03(R2012) .....Gray Iron Castings
- A53/A53M-12 .....Pipe, Steel, Black and Hot-Dipped Zinc-Coated Welded and  
Seamless
- A123/A123M-13 .....Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- A153/A153M-09 .....Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- A307-14.....Carbon Steel Bolts, Studs and Threaded Rod 60,000 PSI Tensile  
Strength
- A653/A653M-13 .....Steel Sheet, Zinc Coated (Galvanized) or Zinc Alloy Coated  
(Galvannealed) by the Hot-Dip Process
- A786/A786M-05(R2009) .....Rolled Steel Floor Plates
- A1008/A1008M-13 .....Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength,  
Low-Alloy
- A1011/A1011M-14 .....Steel, Sheet and Strip, Strip, Hot-Rolled Carbon, Structural,  
High-Strength, Low-Alloy
- C. American Welding Society (AWS):
- D1.1/D1.1M-10.....Structural Welding Code-Steel
- D1.3/D1.3M-08.....Structural Welding Code-Sheet Steel
- D. The National Association of Architectural Metal Manufacturers (NAAMM) Manuals:
- MBG 531-09.....Metal Bar Gratings
- AMP521-01 .....Pipe Railing Manual, Including Round Tube
- E. American Iron and Steel Institute (AISI):
- S100-12.....Design of Cold-Formed Steel Structural Members
- F. National Fire Protection Association (NFPA):
- 101-15 .....Life Safety Code
- G. Society for Protective Coatings (SSPC):
- Paint 25(1997; E 2004) .....Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand  
Cleaned Steel, Type I and Type II

## **PART 2 - PRODUCTS**

### **2.1 DESIGN CRITERIA:**

- A. Design stairs to support live load of 4.79 kN/sq. m (100 lbf/ sq. ft.) and a concentrated load of 1.33 kN (300 lbf) applied on an area of 2580 sq. mm (4 sq. in.).

1. Uniform and concentrated loads need not be assumed to act concurrently.
  2. Provide stair framing capable of withstanding stresses resulting from railing loads in addition to the loads specified above. Limit deflection of treads, platforms, and framing members to  $L/360$  or 6.4 mm (1/4 inch), whichever is less.
- B. Provide fabrication and assembly in accordance with requirements of NAAMM Metal Stairs Manual, except as otherwise specified or shown.
- C. Design Grating treads in accordance with NAAMM Metal Bar Grating Manual.
- D. Design handrails and top rails of guards to support uniform load of not 0.73 kN/m (50 lbf/ft.) applied in any direction and a concentrated load of 0.89 kN (200 lbf) applied in any direction. Uniform and concentrated loads need not be assumed to act concurrently.
- E. Infill of guards to support concentrated load of 0.22 kN (50 lbf) applied horizontally on an area of 0.093 sq. m (1 sq. ft.).

## **2.2 MATERIALS:**

- A. Steel Pipe: ASTM A53/A53M, Standard Weight, zinc coated.
- B. Structural Steel: ASTM A36/A36M.
- E. Steel Floor Plate: ASTM A786/A786M.
- F. Steel Decking: Form from zinc coated steel conforming to ASTM A653/A653M, with properties conforming to AISI S100 Specification for the Design of Cold-Formed Steel Structural Members.

## **2.3 FABRICATION GENERAL:**

- A. Fasteners:
1. Conceal bolts and screws wherever possible.
  2. Use countersunk heads on exposed bolts and screws with ends of bolts and screws dressed flush after nuts are set.
  3. Galvanized zinc-coated fasteners in accordance with ASTM A153/A153M and used for exterior applications or where built into exterior walls or floor systems. Select fasteners for the type, grade, and class required for the installation of steel stair items.
  4. Standard/regular hexagon-head bolts and nuts be conforming to ASTM A307, Grade A.
  5. Square-head lag bolts conforming to ASME B18.2.3.8M, ASME B18.2.1.
  6. Machine screws cadmium-plated steel conforming to ASME B18.6.7M, ASME B18.6.3.
  7. Wood screws, flat-head carbon steel conforming to ASME B18.6.5M, ASME B18.6.1.
  8. Plain washers, round, general-assembly-grade, carbon steel conforming to ASME B18.22M, ASME B18.21.1.
  9. Lockwashers helical spring, carbon steel conforming to ASME B18.2.1, ASME B18.2.3.8M.
- B. Welding:
1. Structural steel, AWS D1.1/D1.1M, and sheet steel, AWS D1.3/D1.3M.
  2. Where possible, locate welds on unexposed side.
  3. Grind exposed welds smooth and true to contour of welded member.

4. Remove welding splatter.
- C. Remove sharp edges and burrs.
- D. Fit stringers to head channel and close ends with steel plates welded in place where shown.
- E. Fit face stringer to newel post by tenoning into newel post, or by notching and fitting face stringer to side of newel where shown.
- F. Shop Prime Painting: Shop prime steelwork with red oxide primer in accordance with SSPC Paint 25.
  1. Hot dip galvanize steelwork as indicated in accordance with ASTM A123/A123M. Touch up abraded surfaces and cut ends of galvanized members with zinc-dust, zinc-oxide primer, or an approved galvanizing repair compound.
- G. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately 0.8 mm (1/32 inch), and bend metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work.
- H. Continuously weld corners and seams in accordance with the recommendations of AWS D1.1/D1.1M. Grind smooth exposed welds and flush to match and blend with adjoining surfaces.
- I. Form exposed connections with hairline joints that are flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of the type indicated or, if not indicated, use Phillips flathead (countersunk) screws or bolts.
- J. Provide and coordinate anchorage of the type indicated with the supporting structure. Fabricate anchoring devices, space as indicated and required to provide adequate support for the intended use of the work.
- K. Use hot-rolled steel bars for work fabricated for bar stock unless work is indicated or specified as fabricated from cold-finished or cold-rolled stock.

## **2.4 RAILINGS:**

- A. Fabricate railings, including handrails, from steel pipe.
  1. Connections may be standard fittings designed for welding, or coped or mitered pipe with full welds.
- B. Return ends of handrail to wall and close free end.
- C. Provide standard terminal castings where fastened to newel.
- D. Space intermediate posts not over 1828 mm (6 feet) on center between end post.
- E. Fabricate handrail brackets from cast malleable iron.
- F. Provide standard terminal fittings at ends of post and rails.

## **2.5 CLOSED RISER STAIRS:**

- A. Provide treads, risers, platforms, railings, stringers, headers and other supporting members.
- B. Fabricate treads and platforms, and risers from sheet steel.
- C. Form risers with sanitary cove.

- D. Fabricate stringers, headers, and other supporting members from structural steel.

### **PART 3 - EXECUTION**

#### **3.1 STAIR INSTALLATION:**

- A. Provide hangers and struts required to support the loads imposed.
- B. Perform job site welding and bolting as specified for shop fabrication.
- C. Set stairs and other members in position and secure to structure as shown.
- D. Install stairs plumb, level and true to line.
- E. Provide steel closure plate to fill gap between the stringer and surrounding wall. Weld and apply primer, ready to accept paint finish.

#### **3.2 RAILING INSTALLATION:**

- A. Install standard terminal fittings at ends of posts and rails.
- B. Secure brackets, posts and rails to steel by welds, and to masonry or concrete with expansion sleeves and bolts, except secure posts at concrete by setting in sleeves filled with commercial non-shrink grout.
- C. Set rails horizontal or parallel to rake of stairs to within 3 mm in 3658 mm (1/8-inch in 12 feet).
- D. Set posts plumb and aligned to within 3 mm in 3658 mm (1/8-inch in 12 feet).

#### **3.3 FIELD PRIME PAINTING:**

- A. Touch-up abraded areas with same primer paint used for shop priming.
- B. Touch up abraded galvanized areas.

--- E N D ---

**SECTION 06 10 00  
ROUGH CARPENTRY**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

- A. This section specifies wood blocking, framing, sheathing, furring, nailers, sub-flooring, rough hardware, and light wood construction.

**1.2 RELATED WORK:**

- A. Gypsum sheathing: Section 09 29 00, GYPSUM BOARD.

**1.3 SUBMITTALS:**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Not Used
- C. Shop Drawings showing framing connection details, fasteners, connections and dimensions.
- D. Manufacturer's Literature and Data:
  - 1. Submit data for lumber, panels, hardware and adhesives.
  - 2. Submit data for wood-preservative treatment from chemical treatment manufacturer and certification from treating plants that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
  - 3. Submit data for fire retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
  - 4. For products receiving a waterborne treatment, submit statement that moisture content of treated materials was reduced to levels specified before shipment to project site.
- E. Manufacturer's certificate for unmarked lumber.

**1.4 PRODUCT DELIVERY, STORAGE AND HANDLING:**

- A. Protect lumber and other products from dampness both during and after delivery at site.
- B. Pile lumber in stacks in such manner as to provide air circulation around surfaces of each piece.
- C. Stack plywood and other board products so as to prevent warping.
- D. Locate stacks on well drained areas, supported at least 152 mm (6 inches) above grade and cover with well-ventilated sheds having firmly constructed over hanging roof with sufficient end wall to protect lumber from driving rain.

**1.5 QUALITY ASSURANCE:**

- A. Installer: A firm with a minimum of three (3) years' experience in the type of work required by this section.

**1.6 GRADING AND MARKINGS:**

- A. Any unmarked lumber or plywood panel for its grade and species will not be allowed on VA Construction sites for lumber and material not normally grade marked, provide manufacturer's



certificates (approved by an American Lumber Standards approved agency) attesting that lumber and material meet the specified the specified requirements.

#### 1.7 APPLICABLE PUBLICATIONS:

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in the text by basic designation only.
- B. American Forest and Paper Association (AFPA):
  - NDS-15 ..... National Design Specification for Wood Construction
  - WCD1-01 ..... Details for Conventional Wood Frame Construction
- C. American Institute of Timber Construction (AITC):
  - A190.1-07..... Structural Glued Laminated Timber
- D. American Society of Mechanical Engineers (ASME):
  - B18.2.1-12(R2013)..... Square and Hex Bolts and Screws
  - B18.2.2-10..... Square and Hex Nuts
  - B18.6.1-81(R2008)..... Wood Screws
- E. American Plywood Association (APA):
  - E30-11 ..... Engineered Wood Construction Guide
- F. ASTM International (ASTM):
  - A653/A653M-13 ..... Steel Sheet Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot Dip Process
  - C954-11 ..... Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases to Steel Studs from 0.033 inch (2.24 mm) to 0.112-inch (2.84 mm) in thickness
  - C1002-14 ..... Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Metal Studs
  - D198-14 ..... Test Methods of Static Tests of Lumber in Structural Sizes
  - D2344/D2344M-13..... Test Method for Short-Beam Strength of Polymer Matrix Composite Materials and Their Laminates
  - D2559-12a ..... Adhesives for Structural Laminated Wood Products for Use Under Exterior (Wet Use) Exposure Conditions
  - D3498-03(R2011) ..... Adhesives for Field-Gluing Plywood to Lumber Framing for Floor Systems
  - D6108-13 ..... Test Method for Compressive Properties of Plastic Lumber and Shapes
  - D6109-13 ..... Test Methods for Flexural Properties of Unreinforced and Reinforced Plastic Lumber and Related Products

- D6111-13a ..... Test Method for Bulk Density and Specific Gravity of Plastic Lumber and Shapes by Displacement
- D6112-13 ..... Test Methods for Compressive and Flexural Creep and Creep-Rupture of Plastic Lumber and Shapes
- F844-07a(R2013) ..... Washers, Steel, Plain (Flat) Unhardened for General Use
- F1667-13 ..... Nails, Spikes, and Staples
- G. American Wood Protection Association (AWPA):
  - AWPA Book of Standards
- H. Commercial Item Description (CID):
  - A-A-55615 ..... Shield, Expansion (Wood Screw and Lag Bolt Self Threading Anchors)
- I. Forest Stewardship Council (FSC):
  - FSC-STD-01-001(Ver. 4-0)FSC Principles and Criteria for Forest Stewardship
- J. Military Specification (Mil. Spec.):
  - MIL-L-19140E ..... Lumber and Plywood, Fire-Retardant Treated
- K. Environmental Protection Agency (EPA):
  - 40 CFR 59(2014) ..... National Volatile Organic Compound Emission Standards for Consumer and Commercial Products
- L. Truss Plate Institute (TPI):
  - TPI-85 ..... Metal Plate Connected Wood Trusses
- M. U.S. Department of Commerce Product Standard (PS)
  - PS 1-95 ..... Construction and Industrial Plywood
  - PS 20-10 ..... American Softwood Lumber Standard
- N. ICC Evaluation Service (ICC ES):
  - AC09 ..... Quality Control of Wood Shakes and Shingles
  - AC174 ..... Deck Board Span Ratings and Guardrail Systems (Guards and Handrails)

## **PART 2 - PRODUCTS**

### **2.1 LUMBER:**

- A. Unless otherwise specified, each piece of lumber must bear grade mark, stamp, or other identifying marks indicating grades of material, and rules or standards under which produced.
  - 1. Identifying marks are to be in accordance with rule or standard under which material is produced, including requirements for qualifications and authority of the inspection organization, usage of authorized identification, and information included in the identification.
  - 2. Inspection agency for lumber approved by the Board of Review, American Lumber Standards Committee, to grade species used.
- B. Not Used

C. Lumber Other Than Structural:

1. Unless otherwise specified, species graded under the grading rules of an inspection agency approved by Board of Review, American Lumber Standards Committee.
2. Not Used
3. Furring, blocking, nailers and similar items 101 mm (4 inches) and narrower Standard Grade; and, members 152 mm (6 inches) and wider, Number 2 Grade.

D. Sizes:

1. Conforming to PS 20.
2. Size references are nominal sizes, unless otherwise specified, actual sizes within manufacturing tolerances allowed by standard under which produced.

E. Moisture Content:

1. Maximum moisture content of wood products is to be as follows at the time of delivery to site.
  - a. Boards and lumber 50 mm (2 inches) and less in thickness: 19 percent or less.
  - b. Lumber over 50 mm (2 inches) thick: 25 percent or less.

F. Fire Retardant Treatment:

1. Comply with Mil Spec. MIL-L-19140.
2. Treatment and performance inspection, by an independent and qualified testing agency that establishes performance ratings.

G. Preservative Treatment:

1. Do not treat Heart Redwood and Western Red Cedar.
2. Treat wood members and plywood exposed to weather or in contact with plaster, masonry or concrete, including framing of open roofed structures; sills, sole plates, furring, and sleepers that are less than 610 mm (24 inches) from ground; nailers, edge strips, blocking, crickets, curbs, cant, vent strips and other members provided in connection with roofing and flashing materials.
3. Treat other members specified as preservative treated (PT).
4. Preservative treat by the pressure method complying with AWPA Book use category system standards U1 and T1, except any process involving the use of Chromated Copper Arsenate (CCA) or other agents classified as carcinogenic for pressure treating wood is not permitted.

**2.2 NOT USED**

**2.3 PLYWOOD:**

- A. Comply with PS 1.
- B. Bear the mark of a recognized association or independent inspection agency that maintains continuing control over quality of plywood which identifies compliance by veneer grade, group number, span rating where applicable, and glue type.
- C. Fire Retardant
- D. Sheathing:

1. Roof sheathing:
  - a. Minimum 9 mm (11/32 inch) thick with span rating 24/0 or 12 mm (15/32 inch) thick with span rating for supports 406 mm (16 inches) on center unless specified otherwise.

## **2.4 NOT USED**

## **2.5 ROUGH HARDWARE AND ADHESIVES:**

- A. Anchor Bolts:
  1. ASME B18.2.1 and ASME B18.2.2 galvanized, 13 mm (1/2 inch) unless shown otherwise.
  2. Extend at least 203 mm (8 inches) into masonry or concrete with ends bent 50 mm (2 inches).
- B. Miscellaneous Bolts: Expansion Bolts: C1D A-A-55615; lag bolt, long enough to extend at least 65 mm (2-1/2 inches) into masonry or concrete. Provide 13 mm (1/2 inch) bolt unless shown otherwise.
- C. Washers
  1. ASTM F844.
  2. Provide zinc or cadmium coated steel or cast iron for washers exposed to weather.
- D. Screws:
  1. Wood to Wood: ASME B18.6.1 or ASTM C1002.
  2. Wood to Steel: ASTM C954, or ASTM C1002.
- E. Nails:
  1. Size and type best suited for purpose unless noted otherwise. Provide aluminum-alloy nails, plated nails, or zinc-coated nails, for nailing wood work exposed to weather and on roof blocking.
  2. ASTM F1667:
    - a. Common: Type I, Style 10.
    - b. Concrete: Type I, Style 11.
    - c. Barbed: Type I, Style 26.
    - d. Underlayment: Type I, Style 25.
    - e. Masonry: Type I, Style 27.
    - f. Provide special nails designed for use with ties, strap anchors, framing connectors, joists hangers, and similar items. Nails not less than 32 mm (1-1/4 inches) long, 8d and deformed or annular ring shank.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION OF FRAMING AND MISCELLANEOUS WOOD MEMBERS:**

- A. Conform to applicable requirements of the following:
  1. AFPA NDS for timber connectors.
  2. AITC A190.1 Timber Construction Manual for heavy timber construction.

3. AFPA WCD1 for nailing and framing unless specified otherwise.
  4. APA for installation of plywood or structural use panels.
  5. TPI for metal plate connected wood trusses.
- B. Fasteners:
1. Nails.
    - a. Nail in accordance with the Recommended Nailing Schedule as specified in AFPA WCD1 where detailed nailing requirements are not specified in nailing schedule. Select nail size and nail spacing sufficient to develop adequate strength for the connection without splitting the members.
    - b. Use special nails with framing connectors.
    - c. For sheathing and subflooring, select length of nails sufficient to extend 25 mm (1 inch) into supports.
    - d. Use 8d or larger nails for nailing through 25 mm (1 inch) thick lumber and for toe nailing 50 mm (2 inch) thick lumber.
    - e. Use 16d or larger nails for nailing through 50 mm (2 inch) thick lumber.
    - f. Select the size and number of nails in accordance with the Nailing Schedule except for special nails with framing anchors.
  2. Bolts:
    - a. Fit bolt heads and nuts bearing on wood with washers.
    - b. Countersink bolt heads flush with the surface of nailers.
    - c. Embed in concrete and solid masonry or provide expansion bolts. Special bolts or screws designed for anchor to solid masonry or concrete in drilled holes may be used.
    - d. Provide toggle bolts to hollow masonry or sheet metal.
    - e. Provide bolts to steel over 2.84 mm (0.112 inch, 11 gage) in thickness. Secure wood nailers to vertical structural steel members with bolts, placed one at ends of nailer and 610 mm (24 inch) intervals between end bolts. Provide clips to beam flanges.
  3. Drill Screws to steel less than 2.84 mm (0.112 inch) thick.
    - a. ASTM C1002 for steel less than 0.84 mm (0.033 inch) thick.
    - b. ASTM C954 for steel over 0.84 mm (0.033 inch) thick.
  4. Power actuated drive pins may be provided where practical to anchor to solid masonry, concrete, or steel.
  5. Do not anchor to wood plugs or nailing blocks in masonry or concrete. Provide metal plugs, inserts or similar fastening.
  6. Screws to Join Wood:
    - a. Where shown or option to nails.
    - b. ASTM C1002, sized to provide not less than 25 mm (1 inch) penetration into anchorage member.

- c. Spaced same as nails.
- 7. Installation of Timber Connectors:
  - a. Conform to applicable requirements of the AFPA NDS.
  - b. Fit wood to connectors and drill holes for fasteners so wood is not split.
- C. Set sills or plates level in full bed of mortar on masonry or concrete walls.
  - 1. Space anchor bolts 1219 mm (4 feet) on centers between ends and within 152 mm (6 inches) of end. Stagger bolts from side to side on plates over 178 mm (7 inches) in width.
  - 2. Provide shims of slate, tile or similar approved material to level wood members resting on concrete or masonry. Do not use wood shims or wedges.
  - 3. Closely fit, and set to required lines.
- D. Cut notch, or bore in accordance with AFPA WCD1 passage of ducts wires, bolts, pipes, conduits and to accommodate other work. Repair or replace miscut, misfit or damaged work.
- E. Blocking Nailers, and Furring:
  - 1. Install furring, blocking, nailers, and grounds where shown.
  - 2. Provide longest lengths practicable.
  - 3. Provide fire retardant treated wood blocking where shown at openings and where shown or specified.
  - 4. Layers of Blocking or Plates:
    - a. Stagger end joints between upper and lower pieces.
    - b. Nail at ends and not over 610 mm (24 inches) between ends.
    - c. Stagger nails from side to side of wood member over 127 mm (5 inches) in width.

--- E N D ---

**SECTION 07 21 13  
THERMAL INSULATION**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Thermal insulation.
    - a. Board or block insulation at foundation perimeter.
    - b. Batt or blanket insulation at exterior framed and furred walls.

**1.2 RELATED REQUIREMENTS**

- A. Safing Insulation: Section 07 84 00, FIRESTOPPING.

**1.3 APPLICABLE PUBLICATIONS**

- A. Comply with references to extent specified in this section.
- B. ASTM International (ASTM):
  - 1. C552-15 - Cellular Glass Thermal Insulation.
  - 2. C553-13 - Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
  - 3. C578-15 - Rigid, Cellular Polystyrene Thermal Insulation.
  - 4. C591-15 - Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
  - 5. C612-14 - Mineral Fiber Block and Board Thermal Insulation.
  - 6. C665-12 - Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
  - 7. C728-15 - Perlite Thermal Insulation Board.
  - 8. C954-15 - Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Base to Steel Studs From 0.033 (0.84 mm) inch to 0.112 inch (2.84 mm) in thickness.
  - 9. C1002-14 - Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
  - 10. D312/D312M-15 - Asphalt Used in Roofing.
  - 11. E84-15a - Surface Burning Characteristics of Building Materials.
  - 12. F1667-15 - Driven Fasteners: Nails, Spikes, and Staples.

**1.4 SUBMITTALS**

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submittal Drawings:
  - 1. Show insulation type, thickness, and R-value for each location.
- C. Manufacturer's Literature and Data:
  - 1. Description of each product.
  - 2. Adhesive indicating manufacturer recommendation for each application.

### **1.5 DELIVERY**

- A. Deliver products in manufacturer's original sealed packaging.
- B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, production run number, and manufacture date.
- C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

### **1.6 STORAGE AND HANDLING**

- A. Store products indoors in dry, weathertight facility.
- B. Protect products from damage during handling and construction operations.
- C. Protect foam plastic insulation from UV exposure.

### **1.7 WARRANTY**

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

## **PART 2 - PRODUCTS**

### **2.1 INSULATION - GENERAL**

- A. Insulation Thickness:
  - 1. Provide thickness required by R-value shown on drawings.
  - 2. Provide thickness indicated when R-value is not shown on drawings.
- B. Insulation Types:
  - 1. Provide one insulation type for each application.

### **2.2 THERMAL INSULATION**

- A. Perimeter Insulation In Contact with Soil:
  - 1. Polystyrene Board: ASTM C578, Type IV, V, VI, VII, or IX.
- B. Exterior Framing or Furring Insulation:
  - 1. Mineral Fiber: ASTM C665, Type II, Class C, Category I where concealed by thermal barrier.
  - 2. Mineral Fiber: ASTM C665, Type III, Class A at other locations.
- C. Masonry Cavity Wall Insulation:
  - 1. Polyurethane or Polyisocyanurate Board: ASTM C591, Type I, with vapor retarder facing; maximum permeance 29 ng/Pa/s/sq. m (0.5 perms).

### **2.3 NOT USED**

### **2.4 ACCESSORIES**

- A. Fasteners:
  - 1. Staples or Nails: ASTM F1667, zinc-coated, size and type to suit application.
  - 2. Screws: ASTM C954 or ASTM C1002, size and length to suit application with washer minimum 50 mm (2 inches) diameter.
  - 3. Impaling Pins: Steel pins with head minimum 50 mm (2 inches) diameter.



- a. Length: As required to extend beyond insulation and retain cap washer when washer is placed on pin.
  - b. Adhesive: Type recommended by manufacturer to suit application.
- B. Insulation Adhesive:
  - 1. Nonflammable type recommended by insulation manufacturer to suit application.
- C. Tape:
  - 1. Pressure sensitive adhesive on one face.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Examine and verify substrate suitability for product installation.
- B. Protect existing construction and completed work from damage.
- C. Clean substrates. Remove contaminants capable of affecting subsequently installed product's performance.

### **3.2 INSTALLATION - GENERAL**

- A. Install products according to manufacturer's instructions and approved submittal drawings.
  - 1. When manufacturer's instructions deviate from specifications, submit proposed resolution for Contracting Officer's Representative consideration.
- B. Install insulation with vapor barrier facing the heated side, unless indicated otherwise.
- C. Install board insulation with joints close and flush, in regular courses, and with end joints staggered.
- D. Install batt and blanket insulation with joints tight. Fill framing voids completely. Seal penetrations, terminations, facing joints, facing cuts, tears, and unlapped joints with tape.
- E. Fit insulation tight against adjoining construction and penetrations, unless indicated otherwise.

### **3.3 THERMAL INSULATION**

- A. Perimeter Insulation In Contact with Soil:
  - 1. Vertical insulation:
    - a. Fill joints of insulation with same material used for bonding.
    - b. Bond polystyrene board to surfaces with adhesive.
    - c. Bond cellular glass insulation to surfaces with hot asphalt or adhesive cement.
  - 2. Horizontal insulation under concrete floor slab:
    - a. Lay insulation boards and blocks horizontally on level, compacted and drained fill.
    - b. Extend insulation from foundation walls towards center of building minimum 600 mm (24 inches).
- B. Exterior Framing or Furring Insulation:
  - 1. General:
    - a. Open voids are not acceptable.

- b. Pack insulation around door frames and windows, in building expansion joints, door soffits, and other voids.
  - c. Pack behind outlets, around pipes, ducts, and services encased in walls.
  - d. Hold insulation in place with pressure sensitive tape.
  - e. Lap facing flanges together over framing for continuous surface. Seal penetrations through insulation and facings.
- 2. Metal Studs:
  - a. Fasten insulation between metal studs, framing, and furring with pressure sensitive tape continuous along flanged edges.
- 3. Ceilings and Soffits:
  - a. Wood Framing:
    - 1) Fasten blanket insulation between wood framing and joists with nails or staples through flanged edges of insulation.
    - 2) Space fastenings maximum 150 mm (6 inches) on center.
  - b. Metal Framing:
    - 1) Fasten insulation between metal framing with pressure sensitive tape continuous along flanged edges.
    - 2) At metal framing and ceilings suspension systems, install insulation above suspended ceilings and metal framing at right angles to main runners and framing.
    - 3) Tape insulation tightly together without gaps. Cover metal framing members with insulation.
  - c. Ceiling Transitions:
    - 1) In areas where suspended ceilings transition to structural ceiling, install blanket or batt insulation.
    - 2) Extend insulation from suspended ceiling to underside of structure above.
    - 3) Secure blanket and batt with continuous cleats to structure above.
- C. Inside Face of Exterior Wall Insulation:
  - 1. Location: On interior face of solid masonry and concrete walls, beams, beam soffits, underside of floors, and to face of studs to support interior wall finish where indicated.
  - 2. Bond insulation to solid vertical surfaces with adhesive. Fill joints with adhesive cement.
  - 3. Fasten board insulation to face of studs with screws, nails or staples. Space fastenings maximum 300 mm (12 inches) on center. Stagger fasteners at board joints. Install fasteners at each corner.
- D. Masonry Cavity Wall Insulation:
  - 1. Install insulation on exterior faces of concrete and masonry inner wythes of cavity walls.
  - 2. Bond polystyrene board to surfaces with adhesive.

3. Bond mineral polyurethane or polyisocyanurate board, and perlite board to surfaces with adhesive.
  4. Bond cellular glass insulation to surfaces with hot asphalt or adhesive cement.
  5. Fill insulation joints with same material used for bonding.
- E. Masonry Fill Insulation:
1. Pour fill insulation in masonry unit hollow cores from tops of walls, or from sill where windows or other openings occur.
  2. Pour in lifts of maximum 6 m (20 feet).

**3.4 NOT USED**

**3.5 CLEANING**

- A. Remove excess adhesive before adhesive sets.

**3.6 PROTECTION**

- A. Protect insulation from construction operations.
- B. Repair damage.

- - E N D - -

**SECTION 07 22 00  
ROOF AND DECK INSULATION**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
- B. Roof and deck insulation, substrate board, vapor retarder, and cover board on new concrete substrates ready to receive roofing or waterproofing membrane.

**1.2 RELATED REQUIREMENTS**

- A. Wood Cants, Blocking, and Edge Strips: Section 06 10 00, ROUGH CARPENTRY.

**1.3 APPLICABLE PUBLICATIONS**

- A. Comply with references to extent specified in this section.
- B. American Society of Heating, Refrigeration and Air Conditioning (ASHRAE):
  - 1. Standard 90.1-13 - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- C. ASTM International (ASTM):
  - 1. C1289-15 - Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
  - 2. C1396/C1396M-14a - Gypsum Board.
  - 3. D41/D41M-11 - Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
  - 4. D312-06 - Asphalt Used in Roofing.
  - 5. D1970/D1970M-15 - Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
  - 6. D2178/D2178M-15 - Asphalt Glass Felt Used in Roofing and Waterproofing.
  - 7. D4586/D4586M-07(2012)e1 - Asphalt Roof Cement, Asbestos-Free.
  - 8. E84-15a - Surface Burning Characteristics of Building Materials.
  - 9. F1667-15 - Driven Fasteners: Nails, Spikes, and Staples.
- D. National Roofing Contractors Association (NRCA):
  - 1. Manual-15 - The NRCA Roofing Manual: Membrane Roof Systems.
- E. U.S. Department of Agriculture (USDA):
  - 1. USDA BioPreferred Program Catalog.
- F. UL LLC (UL):
  - 1. Listed - Online Certifications Directory.
- G. U.S. Department of Commerce National Institute of Standards and Technology (NIST):
  - 1. DOC PS 1-09 - Structural Plywood.
  - 2. DOC PS 2-04 - Performance Standard for Wood-Based Structural-Use Panels.

**1.4 SUBMITTALS**

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submittal Drawings:

1. Show size, configuration, and installation details.
  - a. Nailers, cants, and terminations.
  - b. Layout of insulation showing slopes, tapers, penetrations, and edge conditions.
- C. Manufacturer's Literature and Data:
  1. Description of each product.
- D. Samples:
  1. Roof insulation, each type.
  2. Fasteners, each type.
- E. Qualifications: Substantiate qualifications meet specifications.
  1. Installer.

## **1.5 QUALITY ASSURANCE**

- A. Installer Qualifications: Same installer as Division 07 roofing section installer.

## **1.6 DELIVERY**

- A. Comply with recommendations of NRCA Manual.
- B. Deliver products in manufacturer's original sealed packaging.
- C. Mark packaging, legibly. Indicate manufacturer's name or brand, type, and manufacture date.
- D. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

## **1.7 STORAGE AND HANDLING**

- A. Comply with recommendations of NRCA Manual.
- B. Store products indoors in dry, weathertight facility.
- C. Protect products from damage during handling and construction operations.

## **1.8 FIELD CONDITIONS**

- A. Environment:
  1. Install products when existing and forecasted weather permit installation according to manufacturer's instructions.

## **1.9 WARRANTY**

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."
- B. Manufacturer's Warranty: Warrant substrate board, vapor retarder, insulation, and cover board against material and manufacturing defects as part of Division 07 roofing system warranty.

## **PART 2 - PRODUCTS**

### **2.1 SYSTEM PERFORMANCE**

- A. Insulation Thermal Performance:
  1. Overall Average R-Value: RSI-57 (R-33), minimum.
  2. Any Location R-Value: RSI-17 (R-10), minimum.

- B. Fire and Wind Uplift Resistance: Provide roof insulation complying with requirements specified in Division 07 roofing section.

## **2.2 PRODUCTS - GENERAL**

- A. Provide each product from one manufacturer.

## **2.3 ADHESIVES**

- A. Primer: ASTM D41/D41M.
- B. Asphalt: ASTM D312, Type III or IV for vapor retarders and insulation.
- C. Modified Asphaltic Insulation Adhesive: Insulation manufacturer's recommended modified asphaltic, asbestos-free, cold-applied adhesive formulated to adhere roof insulation to substrate or to another insulation layer.
- D. Bead-Applied Urethane Insulation Adhesive: Insulation manufacturer's recommended bead-applied, low-rise, one- or multicomponent urethane adhesive formulated to adhere roof insulation to substrate or to another insulation layer.
- E. Full-Spread Applied Urethane Insulation Adhesive: Insulation manufacturer's recommended spray-applied, low-rise, two-component urethane adhesive formulated to adhere roof insulation to substrate or to another insulation layer.
- F. Roof Cement: Asbestos free, ASTM D2822/D2822M, Type I or Type II; or, ASTM D4586/D4586M, Type I or Type II.

## **2.4 ROOF AND DECK INSULATION**

- A. Roof and Deck Insulation, General: Preformed roof insulation boards approved by roofing manufacturer.
- B. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2, faced with glass fiber reinforced cellulosic felt facers on both major surfaces of the core foam.
- C. Tapered Roof Insulation System:
  - 1. Fabricate polyisocyanurate. Use only one insulation material for tapered sections. Use only factory-tapered insulation.
  - 2. Cut to provide high and low points with crickets and slopes as shown.
  - 3. Minimum thickness of tapered sections; 38 mm (1-1/2 inch).
  - 4. Minimum slope 1/48 (1/4 inch per 12 inches).

## **2.5 INSULATION ACCESSORIES**

- A. Glass (Felt): ASTM D2178/D2178M, Type VI, heavy duty ply sheet.
- B. Cants and Tapered Edge Strips:
- C. Vapor Retarder:
  - 1. Glass-Fiber Felts: ASTM D2178/D2178M, Type IV, asphalt impregnated.
  - 2. Self-Adhering Sheet Vapor Retarder: ASTM D1970/D1970M, minimum 1.0 mm (40 mils) thick membrane of HDPE film fully coated with asphalt adhesive, or 0.76 to 1.0 mm (30 to

40 mils) thick membrane of butyl rubber based adhesive backed by a layer of high density cross-laminated polyethylene; maximum permeance rating of 6 ng/Pa/s/sq. m (0.1 perms).

D. Cover Board:

1. Glass-Mat, Water-Resistant Gypsum Roof Board: ASTM C1177/C1177M, 13 mm (1/2 inch) thick, factory primed.

## 2.6 ACCESSORIES

- A. Fasteners: Corrosion-resistant carbon steel fasteners and galvalume-coated steel or plastic round plates for fastening substrate board and insulation to roof deck.
- B. Nails: ASTM F1667; type to suit application.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Comply with requirements of Division 07 roofing section.

### 3.2 PREPARATION

- A. Examine and verify substrate suitability for product installation.
- B. Protect existing construction and completed work from damage.

### 3.3 INSTALLATION - GENERAL

- A. Install products according to manufacturer's instructions.
  1. When manufacturer's instructions deviate from specifications, submit proposed resolution for Contracting Officer's Representative consideration.
- B. Comply with requirements of UL for insulated steel roof deck.
- C. Attach substrate board and other products to meet requirements of Division 07 roofing section.

### 3.4 INSULATION INSTALLATION

- A. Insulation Installation, General:
  1. Base Sheet: Where required by roofing system, install one lapped base sheet specified in Division 07 roofing section by mechanically fastening to roofing substrate before installation of insulation.
- B. Insulation Thickness:
  1. Thickness of roof insulation shown on drawings is nominal. Provide thickness required to comply with specified thermal performance.
  2. Insulation on Metal Decks: Provide insulation in minimum thickness recommended by insulation manufacturer to span deck flutes. Support edges of insulation on metal deck ribs.
  3. When actual insulation thickness differs from drawings, coordinate alignment and location of roof drains, flashing, gravel stops, fascias and similar items.
  4. Where tapered insulation is used, maintain insulation thickness at high points and roof edges shown on drawings.

- a. Low Point Thickness: Minimum 38 mm (1-1/2 inches).
- 5. Use minimum two layers of insulation when required thickness is 68 mm (2.7 inch) or greater.
- C. Lay insulating units with close joints, in regular courses and with end joints staggered.
  - 1. Stagger joints between layers minimum 150 mm (6 inches).
- D. Lay units with long dimension perpendicular to the rolled (longitudinal) direction of the roofing felt.
- E. Seal cut edges at penetrations and at edges against blocking with bitumen or roof cement.
- F. Cut to fit tightly against blocking or penetrations.
- G. Cover all insulation installed on the same day; comply with temporary protection requirements of Division 07 roofing section.
- H. Installation Method:
  - 1. Adhered Insulation:
    - a. Prime substrate as required.
    - b. Set each layer of insulation firmly in uniform application of full-spread insulation adhesive.
  - 2. Mechanically Fastened and Adhered Insulation:
    - a. Fasten first layer of insulation according to "Mechanically Fastened Insulation" requirements.
    - b. Fasten each subsequent layer of insulation according to "Adhered Insulation" requirements.

### **3.5 COVER BOARD INSTALLATION**

- A. Install cover boards over insulation with long joints in continuous straight lines with staggered end joints.
- B. Offset cover board joints from insulation joints 150 mm (6 inches), minimum.
- C. Secure cover boards according to "Adhered Insulation" requirements.

- - E N D - -



**SECTION 07 31 13  
ASPHALT SHINGLES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Fiberglass asphalt shingles over underlayment nailed to roof sheathing.

**1.2 RELATED REQUIREMENTS**

- A. Counterflashing and Flashing of Roof Projections: Section 07 60 00, FLASHING AND SHEET METAL.

**1.3 APPLICABLE PUBLICATIONS**

- A. Comply with references to extent specified in this section.
- B. ASTM International (ASTM):
  - 1. D226/D226M-09 - Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
  - 2. D1970/D1970M-15a - Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
  - 3. D3018/D3018M-11 - Class A Asphalt Shingles Surfaced with Mineral Granules.
  - 4. D3161/D3161M-15 - Wind-Resistance of Steep Slope Roofing Products (Fan-Induced Method).
  - 5. D3462/D3462M-10a - Asphalt Shingles Made from Glass Felt and Surfaced with Mineral Granules.
  - 6. F1667-05(2011) - Driven Fasteners: Nails, Spikes, and Staples.
- C. UL LLC (UL):
  - 1. 790-14 - Fire Tests of Roof Coverings.

**1.4 SUBMITTALS**

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
  - 1. Description of each product.
  - 2. Installation instructions.
  - 3. Warranty.
- C. Samples:
  - 1. Shingles: Full size each type, color and texture.

**1.5 DELIVERY**

- A. Deliver products in manufacturer's original sealed packaging.
- B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, color, production run number, manufacture date, and the label of Underwriters Laboratories.
- C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

## **1.6 STORAGE AND HANDLING**

- A. Store shingles according to manufacturer's instructions. Store roll goods on end in upright position.
- B. Protect products from damage during handling and construction operations.
- C. Keep materials dry, covered completely and protected from weather.

## **1.7 WARRANTY**

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."
- B. Manufacturer's Warranty: Warrant asphalt shingles against material and manufacturing defects.
  - 1. Material Warranty Period: 25 years.

# **PART 2 - PRODUCTS**

## **2.1 PRODUCTS - GENERAL**

- A. Basis of Design: see drawings.
- B. Provide each product from one manufacturer.
  - 1. Provide each product exposed to view from one production run.

## **2.2 ASPHALT SHINGLES**

- A. Asphalt Shingles: Fiberglass reinforced, laminated type, square butt.
  - 1. ASTM D3462/D3462M and ASTM D3018/D3018M, Type I, self-sealing.
  - 2. ASTM D3161/D3161M, Class D or F wind-resistant.
  - 3. UL 790 Class A fire resistance.
  - 4. Minimum Weight: 10.3 kg/sq. m (210 lbs./100 sq. ft.).

## **2.3 ROOFING NAILS**

- A. ASTM F1667, Type I, Style 20, galvanized steel, deformed shanks, heads 10 mm to 11 mm (3/8 inch to 7/16 inch) diameter.
  - 1. Nails for Shingles: 32 mm (1-1/4 inches) long.
  - 2. Nails for Felt: 19 mm (3/4 inch) long.

## **2.4 ROOFING UNDERLAYMENT**

- A. Organic Felt: ASTM D226/D226M, Type I.
- B. Self-Adhering Modified Bituminous Underlayment: ASTMD1970/D1970M.

## **2.5 METAL FLASHING**

- A. Provide metal roof flashings, including apron flashings, step flashings, valley flashings, drip edges, and vent pipe flashings specified in Section 07 60 00, FLASHING AND SHEET METAL.

# **PART 3 - EXECUTION**

## **3.1 PREPARATION**

- A. Examine and verify substrate suitability for roofing installation.

1. Verify roof substrates are sound, within manufacturer's tolerances, and free from defects which would interfere with roofing installation.
  2. Verify roof accessories, vent pipes and other projections through roof are in place and roof flashing is installed, or ready for installation, before installing shingles.
- B. Protect existing construction and completed work from damage.

### **3.2 INSTALLATION - GENERAL**

- A. Install products according to manufacturer's instructions and approved submittal drawings.
1. When manufacturer's instructions deviate from specifications, submit proposed resolution for Contracting Officer's Representative consideration.

### **3.3 METAL DRIP EDGE INSTALLATION**

- A. At eaves and rakes, install stainless steel drip edges specified in Section 07 60 00, FLASHING AND SHEET METAL.
1. Eaves: Install metal drip edge before underlayment.
  2. Rakes: Install metal drip edge after underlayment.
- B. Secure metal drip edges with compatible nails spaced maximum 250 mm (10 inches) on center along inner edges.

### **3.4 FLASHING INSTALLATION**

- A. Install metal flashings specified in Section 07 60 00, FLASHING AND SHEET METAL at intersections of roofs, adjoining walls, or projections through deck such as chimneys and vent stacks.
- B. Install metal valley flashing shown and as specified under Section 07 60 00, FLASHING AND SHEET METAL.
1. Secure valley flashing according to shingle manufacturer's instructions.
  2. Expose flashing in open portion of valley 125 mm (5 inches) minimum, and lap shingles over flashing 125 mm (5 inches) minimum.

### **3.5 UNDERLAYMENT INSTALLATION**

- A. Install self-adhering sheet underlayment, working from low point to high point. Lap sides 90 mm (3-1/2 inches) minimum, and lap ends 150 mm (6 inches) minimum. Install at the following locations:
1. Eaves and Rakes: From edge of eave and rake to 600 mm (24 inches) minimum beyond inside face of exterior wall.
    - a. Lap underlayment over eave metal drip edge.
  2. Valleys, Hips and Roof Slope Transitions: Centered over change in slope, and extended 450 mm (18 inches) minimum on both sides.
  3. Ridges: Centered on ridge, and extended 900 mm (36 inches) minimum on both sides.

4. Sidewalls and Projections through Roof: Extended 450 mm (18 inches) from projection, and extended up projection 100 mm (4 inches) minimum.
  5. Firmly roll underlayment to ensure adhesion to roof deck and metal flashings.
- B. Install organic felt underlayment on roof deck not covered by self-adhering sheet underlayment, with 100 mm (4 inches) minimum end laps, 50 mm (2 inches) minimum head laps, and 300 mm (12 inches) minimum ridge laps. Nail felt 125 mm (5 inches) on centers along laps.

### **3.6 ASPHALT SHINGLE INSTALLATION**

- A. Install shingles aligned parallel to roof eave, nailed to roof sheathing.
1. Exposure: 125 mm (5 inches) maximum.
  2. Headlap: 50 mm (2 inches) minimum.
- B. Install asphalt-shingle starter strip with tabs removed, and overhanging lower edge of roof 13 mm (1/2 inch).
- C. Valleys: Open.

### **3.7 RIDGE SHINGLE INSTALLATION**

- A. Bend each shingle lengthwise down center to provide equal exposure on both sides of ridge.
1. Begin ridge installation at leeward end of ridge. Cover ridge vents with shingles.
  2. Begin hip installation at eave.
- B. Install shingles with maximum 125 mm (5 inches) exposure.
- C. Secure each shingle with one nail on both sides of ridge, 215 mm (8-1/2 inches) back from exposed end and one inch up from edge.

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**SECTION 07 40 00**  
**METAL SIDING PANELS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies un-insulated metal wall panels as shown.

**1.2 RELATED WORK**

- A. Sealant: Section 07 92 00, JOINT SEALANTS.

**1.3 MANUFACTURER'S QUALIFICATIONS**

Metal wall panels shall be products of a manufacturer regularly engaged in the fabrication and erection of metal panels of the type and design shown and specified.

**1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Samples: Metal panel, 150 mm (six inch) square, showing finish, each color and texture.
- C. Shop Drawings: Wall panels, showing details of construction and installation, thickness and kind of material, closures, flashing, fastenings and related components and accessories.
- D. Manufacturer's Literature and Data: Wall panels

**1.5 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
  - A653/A653M-07..... Steel Sheet, Zinc-Coated (Galvanized), or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - A463-06 ..... Steel Sheet, Cold-Rolled, Aluminum-Coated, by the Hot-Dip Process
  - A924/A924M-07..... Steel Sheet, Metallic Coated by the Hot-Dip Process
  - A1008/A1008M-07..... Steel, Sheet, Cold-Rolled, Carbon, Structural, High Strength Low Alloy
  - B209/209M-07 ..... Aluminum and Aluminum Alloy Sheet and Plate

**PART 2 - PRODUCTS**

**2.1 SHEET STEEL**

- A. Minimum 0.7mm thick for wall panels.
- B. Steel, Sheet, Galvanized: ASTM A653/A653M, Structural.
  - 1. Grade 40, galvanized coating conforming to ASTM A924/A924M, Class Z 275 G-90.

**2.2 FASTENERS**

Fasteners for steel panels shall be galvanized or cadmium plated steel.

Fasteners of size, type and holding strength as recommended by manufacturer.

## **2.3 FABRICATION**

- A. Un-insulated metal wall panels shall be single sheets, of approximate overall depth and configuration shown on drawings. Connection between panels shall be by interlocking joints filled with sealing compound as specified in Section 07 92 00, JOINT SEALANTS. Furnish wall panels in one continuous length for vertical installation as indicated with no horizontal joints, except at openings. Construct panels as follows:
  - 1. Wall panels:
    - a. 0.0276 inch thick galvanized steel.
  - 2. Accessories and flashing shall be the same material as the panels. Thickness and installation of accessories and flashing shall be as recommended by the panel manufacturer.

## **2.4 FINISH**

- A. For steel face sheets, the finishes shall be as follows:
  - 1. Fluorocarbon finish, consisting of a prime coat and a polyvinylidene fluoride finish coat of 1.0 mil minimum dry film thickness on one side, and a wash coat of 0.5 mil minimum dry film thickness applied to reverse side.
  - 2. Finish color shall be selected from manufacturer's full line of standard color section.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. General: Install panels in accordance with the manufacturer's approved erection instructions and diagrams, except as specified otherwise. Panels shall be in full and firm contact with supports and with each other at side and end laps. Where panels are cut in the field, or where any of the factory applied coverings or coatings are abraded or damaged in handling or installation, they shall, after the necessary repairs have been made with material of the same type and color as the weather coating, be approved before being installed. All cut ends and edges, including those at openings through the sheets shall be sealed completely. Correct defects or errors in the materials in an approved manner. Replace materials which cannot be corrected in an approved manner with non defective material. Provide molded closure strips where indicated and whenever sheets terminate with open ends after installation.
- B. Wall Panels: Apply panels with the configuration in a horizontal position. Provide panels in the longest obtainable lengths, with end laps occurring only at structural members. Seal side and end laps with joint sealing material. Flash and seal walls at the base, at the top, around windows, door frames, framed louvers, and other similar openings. Install closure strips, flashings, and sealing material in an approved manner that will assure complete weather tightness. Flashing will not be required where approved "self-flashing" panels are used.
- C. Flashing: All flashing and related closures and accessories in connection with the preformed metal panels shall be provided as indicated and as necessary to provide a watertight installation.

Details of installation, which are not indicated, shall be in accordance with the panel manufacturer's printed instruction and details, or the approved shop drawings. Installation shall allow for expansion and contraction of flashing.

- D. Fasteners: Fastener spacing shall be in accordance with the manufacturer's recommendations, and as necessary to withstand the design loads indicated. Install fasteners in valleys or crowns as recommended by the manufacturer of the sheet being used. Install fasteners in straight lines within a tolerance of 13 mm (1/2-inch) in the length of a bay. Drive exposed penetrating type fasteners normal to the surface, and to a uniform depth to seat gasketed washers properly, and drive so as not to damage factory applied coating. Exercise extreme care in drilling pilot holes for fastenings to keep drills perpendicular and centered in valleys, or crowns, as applicable. After drilling, remove metal filings and burrs from holes prior to installing fasteners and washers. Torque used in applying fasteners shall not exceed that recommended by the manufacturer. Remove panels deformed or otherwise damaged by over-torqued fastenings, and provide new panels. Remove metal shavings and filings from roofs on completion to prevent rusting and discoloration of the panels.

### **3.2 PROTECTION AND CLEANING**

- A. Protect panels and other components from damage during and after erection, and until project is accepted by the Government.
- B. After completion of work, all exposed finished surfaces of panels shall be cleaned of soil, discoloration and disfiguration. Touch-up abraded surfaces of panels.

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**SECTION 07 53 23**  
**ETHYLENE-PROPYLENE-DIENE-MONOMER ROOFING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Ethylene Propylene Diene Monomer (EPDM) sheet roofing adhered to insulated roof deck insulation.

**1.2 RELATED REQUIREMENTS**

- A. Substrate Board, Vapor Retarder, Roof Insulation, and Cover Board: Section 07 22 00, ROOF AND DECK INSULATION.

**1.3 APPLICABLE PUBLICATIONS**

- A. Comply with references to extent specified in this section.
- B. American National Standards Institute/Single-Ply Roofing Institute (ANSI/SPRI):
  - 1. FX-1-01(R2006) - Standard Field Test Procedure for Determining the Withdrawal Resistance of Roofing Fasteners.
  - 2. RP-4 2013 - Wind Design Standard for Ballasted Single-ply Roofing Systems.
- C. American Society of Civil Engineers/Structural Engineering Institute (ASCE/SEI):
  - 1. 7-10 - Minimum Design Loads For Buildings and Other Structures.
- D. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE):
  - 1. 90.1-13 - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- E. ASTM International (ASTM):
  - 1. A276/A276M-15 - Stainless Steel Bars and Shapes.
  - 2. B209-14 - Aluminum and Aluminum-Alloy Sheet and Plate.
  - 3. B209M-14 - Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
  - 4. C67-14 - Sampling and Testing Brick and Structural Clay Tile.
  - 5. C140/C140M-15 - Sampling and Testing Concrete Masonry Units and Related Units.
  - 6. C936/C936M-15 - Solid Concrete Interlocking Paving Units.
  - 7. C1371-15 - Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers.
  - 8. C1549-09(2014) - Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer.
  - 9. D751-06(2011) - Coated Fabrics.
  - 10. D1248-12 - Polyethylene Plastics Extrusion Materials for Wire and Cable.
  - 11. D1876-08(2015)e1 - Peel Resistance of Adhesives (T-Peel Test).
  - 12. D2103-15 - Polyethylene Film and Sheeting.
  - 13. D2240-05(2010) - Rubber Property-Durometer Hardness.



14. D3884-09(2013)e1 - Abrasion Resistance of Textile Fabrics (Rotary Platform, Double-Head Method).
15. D4263-83(2012) - Indicating Moisture in Concrete by the Plastic Sheet Method.
16. D4586/D4586M-07(2012)e1 - Asphalt Roof Cement, Asbestos-Free.
17. D4637/D4637M-14e1 - EPDM Sheet Used In Single-Ply Roof Membrane.
18. E96/E96M-15 - Water Vapor Transmission of Materials.
19. E408-99(2015) - Total Normal Emittance of Surfaces Using Inspection-Meter Techniques.
20. E1918-06(2015) - Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field.
21. E1980-11 - Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field.
22. G21-15 - Resistance of Synthetic Polymeric Materials to Fungi.
- F. Cool Roof Rating Council (CRRC):
  1. 1-15 - Product Rating Program.
- G. Federal Specifications (Fed. Spec.):
  1. UU-B-790A - Building Paper, Vegetable Fiber: (Kraft, Waterproofed, Water Repellent and Fire Resistant).
- H. Florida Department of Business and Professional Regulation (FL):
  1. Approved - Product Approval.
- I. National Roofing Contractors Association (NRCA):
  1. Manual-15 - The NRCA Roofing Manual: Membrane Roof Systems.
- J. U.S. Department of Agriculture (USDA): USDA BioPreferred Catalog.
- K. UL LLC (UL):
  1. 580-06 - Tests for Uplift Resistance of Roof Assemblies.
  2. 1897-15 - Uplift Tests for Roof Covering Systems.
- L. U.S. Department of Commerce National Institute of Standards and Technology (NIST):
  1. DOC PS 1-09 - Structural Plywood.
  2. DOC PS 2-04 - Performance Standard for Wood-Based Structural-Use Panels.
- M. U.S. Environmental Protection Agency (EPA):
  1. Energy Star - ENERGY STAR Program Requirements for Roof Products Version 3.0. //

#### **1.4 PREINSTALLATION MEETINGS**

- A. Conduct preinstallation meeting at the Project site minimum 30 days before beginning Work of this section.
  1. Required Participants:
    - a. Contracting Officer's Representative.
    - b. Architect/Engineer.
    - c. Contractor.

- d. Installer.
  - e. Manufacturer's field representative.
  - f. Other installers responsible for adjacent and intersecting work, including roof deck, flashings, roof specialties, roof accessories, utility penetrations, rooftop curbs and equipment, lightning protection, and
2. Meeting Agenda: Distribute agenda to participants minimum 3 days before meeting.
- a. Installation schedule.
  - b. Installation sequence.
  - c. Preparatory work.
  - d. Protection before, during, and after installation.
  - e. Installation.
  - f. Terminations.
  - g. Transitions and connections to other work.
  - h. Inspecting and testing.
  - i. Other items affecting successful completion.
  - j. Pull out test of fasteners.
  - k. Material storage, including roof deck load limitations.
3. Document and distribute meeting minutes to participants to record decisions affecting installation.

## **1.5 SUBMITTALS**

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submittal Drawings:
  - 1. Roofing membrane layout.
  - 2. Roofing membrane seaming and joint details.
  - 3. Roof membrane penetration details.
  - 4. Base flashing and termination details.
- C. Manufacturer's Literature and Data:
  - 1. Description of each product.
  - 2. Minimum fastener pull out resistance.
  - 3. Installation instructions.
  - 4. Warranty.
- D. Sustainable Construction Submittals:
  - 1. Solar Reflectance Index (SRI) for roofing membrane.
  - 2. Low Pollutant-Emitting Materials:
    - a. Show volatile organic compound types and quantities.
  - 3. Energy Star label for roofing membrane.
- E. Samples:

1. Roofing Membrane: 150 mm (6 inch) square.
  2. Base Flashing: 150 mm (6 inch) square.
  3. Fasteners: Each type.
  4. Roofing Membrane Seam: 300 mm (12 inches) square.
- F. Certificates: Certify products comply with specifications.
1. Fire and windstorm classification.
  2. Energy performance requirements.
- G. Qualifications: Substantiate qualifications comply with specifications.
1. Installer, including supervisors with project experience list .
  2. Manufacturer's field representative with project experience list.
- H. Field quality control reports.
- I. Operation and Maintenance Data:
1. Maintenance manuals.

#### **1.6 QUALITY ASSURANCE**

- A. Installer Qualifications:
1. Approved by roofing system manufacturer as installer for roofing system with specified warranty.
  2. Regularly installs specified products.
  3. Installed specified products with satisfactory service on five similar installations for minimum five years.
  4. Employs full-time supervisors experienced installing specified system and able to communicate with Contracting Officer's Representative and installer's personnel.
- B. Manufacturer's Field Representative:
1. Manufacturer's full-time technical employee or independent roofing inspector.
  2. Individual certified by Roof Consultants Institute as Registered Roof Observer.

#### **1.7 DELIVERY**

- A. Deliver products in manufacturer's original sealed packaging.
- B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, and manufacture date.
- C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

#### **1.8 STORAGE AND HANDLING**

- A. Comply with NRCA Manual storage and handling requirements.
- B. Store products indoors in dry, weathertight facility.
- C. Store adhesives according to manufacturer's instructions.
- D. Protect products from damage during handling and construction operations.
- E. Products stored on the roof deck must not cause permanent deck deflection.

## **1.9 FIELD CONDITIONS**

- A. Environment:
  - 1. Product Temperature: Minimum 4 degrees C (40 degrees F) and rising before installation.
  - 2. Weather Limitations: Install roofing only during dry current and forecasted weather conditions.

## **1.10 WARRANTY**

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."
- B. Manufacturer's Warranty: Warrant roofing system against material and manufacturing defects and agree to repair any leak caused by a defect in the roofing system materials or workmanship of the installer.
  - 1. Warranty Period: 10 years.

## **PART 2 - PRODUCTS**

### **2.1 SYSTEM DESCRIPTION**

- A. Roofing System: Adhered roofing membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards copings and edge metal

### **2.2 SYSTEM PERFORMANCE**

- A. Design roofing system meeting specified performance:
  - 1. Load Resistance: ASCE/SEI 7;
  - 2. Energy Performance:
    - a. EPA Energy Star Listed for low-slope roof products.
    - b. ASTM E1980; Minimum 78 Solar Reflectance Index (SRI).
    - c. Three-Year Aged Performance: Minimum 0.55 solar reflectance tested in according to ASTM C1549 or ASTM E1918, and minimum 0.75 thermal emittance tested in according to ASTM C1371 or ASTM E408.

Where tested aged values are not available:

Calculate compliance adjusting initial solar reflectance according to ASHRAE 90.1.

Provide roofing system with minimum 64 three-year aged Solar Reflectance Index calculated according to ASTM E1980 with 12 W/sq. m/degree K (2.1 BTU/h/sq. ft.) convection coefficient.

### **2.3 PRODUCTS - GENERAL**

- A. Provide roof system components from one manufacturer.
- B. Sustainable Construction Requirements:
- C. EPDM Sheet: ASTM D4637/D4637M, Type I - non-reinforced.
  - 1. Thickness: 1.5 mm (60 mils).
  - 2. Color: White

D. Additional Properties:

PROPERTY	TEST METHOD	REQUIREMENT
Shore A Hardness	ASTM D2240	55 to 75 Durometer
Water Vapor Permeance	ASTM E96/E96M	Minimum 8 ng/Pa/s/sq. m (0.14 perms) Water Method
Fungi Resistance	ASTM G21	After 21 days, no sustained growth or discoloration.

## 2.4 MEMBRANE ACCESSORY MATERIALS

- A. Sheet roofing manufacturer's specified products.
- B. Flashing Sheet: Manufacturer's standard; same material, and color as roofing membrane.
  - 1. Self-curing EPDM flashing adaptable to irregular shapes and surfaces.
  - 2. Minimum Thickness: 1.5 mm (0.060 inch).
- C. Factory Formed Flashings: Inside and outside corners, pipe boots, and other special flashing shapes to minimize field fabrication.
- D. Splice Adhesive or Tape: Manufacturer's standard for roofing membrane and flashing sheet.
- E. Splice Lap Sealant: Liquid EPDM rubber for exposed lap edge.
- F. Bonding Adhesive: Manufacturer's standard, water or solvent based, to suit substrates.
- G. Termination Bars: Manufacturer's standard, stainless steel or aluminum, 25 mm wide by 3 mm thick (1 inch wide by 1/8 inch thick) factory drilled for fasteners.
- H. Battens: Manufacturer's standard, galvanized or galvanized steel, 25 mm wide by 1.3 mm thick (1 inch wide by 0.05 inch thick), factory punched for fasteners.
- I. Pipe Compression Clamp:
  - 1. Stainless steel drawband.
  - 2. Worm drive clamp device.
- J. Fasteners: Manufacturer's standard coated steel with metal or plastic plates, to suit application.
- K. Fastener Sealer: One part elastomeric adhesive sealant.
- L. Temporary Closure Sealers (Night Sealant): Polyurethane two part sealer.
- M. Primers, Splice Tapes, Cleaners, and Butyl Rubber Seals: As specified by roof membrane manufacturer.
- N. Asphalt Roof Cement: ASTM D4586/D4586M.

## 2.5 ACCESSORIES

- A. Temporary Protection Materials:
  - 1. Expanded Polystyrene (EPS) Insulation: ASTM C578.
  - 2. Plywood: NIST DOC PS 1, Grade CD Exposure 1.
  - 3. Oriented Strand Board (OSB): NIST DOC PS 2, Exposure 1.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine and verify substrate suitability for product installation with roofing installer and roofing inspector present.
  - 1. Verify roof deck is adequately secured to resist wind uplift.
  - 2. Verify roof deck is clean, dry, and in-plane ready to receive roofing system.
- B. Correct unsatisfactory conditions before beginning roofing work.

#### **3.2 PREPARATION**

- A. Complete roof deck construction before beginning roofing work:
  - 1. Curbs, blocking, edge strips, and other components to which roofing and base flashing is attached in place ready to receive insulation and roofing.
  - 2. Coordinate roofing membrane installation with flashing work and roof insulation work so insulation and flashing are installed concurrently to permit continuous roofing operations.
  - 3. Complete installation of flashing, insulation, and roofing in same day except for the area where temporary protection is required when work is stopped for inclement weather or end of work day.
- B. Dry out surfaces including roof deck flutes, that become wet from any cause during progress of the work before roofing work is resumed. Apply materials to dry substrates, only.
- C. Broom clean roof decks. Remove dust, dirt and debris.
- D. Remove projections capable of damaging roofing materials.
- E. Concrete Decks, except Insulating Concrete:
  - 1. Test concrete decks for moisture according to ASTM D4263 before installing roofing materials.
  - 2. Prime concrete decks. Keep primer back 100 mm (four inches) from precast concrete deck joints.
  - 3. Allow primer to dry before application of bitumen.
- F. Insulating Concrete Decks:
  - 1. Allow deck to dry out minimum five days after installation before installing roofing materials.
  - 2. Allow additional drying time when precipitation occurs before installing roofing materials.

#### **3.3 TEMPORARY PROTECTION**

- A. Install temporary protection consisting of a temporary seal and water cut-offs at the end of each day's work and when work is halted for an indefinite period or work is stopped when precipitation is imminent.
- B. Install temporary cap flashing over top of base flashings where permanent flashings are not in place to protect against water intrusion into roofing system. Securely anchor in place to prevent blow off and damage by construction activities.

- C. Temporarily seal exposed insulation surfaces within roofing membrane.
  - 1. Apply temporary seal and water cut off by extending roofing membrane beyond insulation and securely embedding edge of the roofing membrane in 6 mm (1/4 inch) thick by 50 mm (2 inches) wide strip of temporary closure sealant. Weight roofing membrane edge with sandbags, to prevent displacement; space sandbags maximum 2400 mm (8 feet) on center.
  - 2. Direct water away from work. Provide drainage, preventing water accumulation.
  - 3. Check daily to ensure temporary seal remains watertight. Reseal open areas and weight down.
- D. Before the work resumes, cut off and discard portions of roof membrane in contact with temporary seal.
  - 1. Cut minimum 150 mm (6 inches) back from sealed edges and surfaces.
- E. Remove sandbags and store for reuse.

### **3.4 INSTALLATION, GENERAL**

- A. Install products according to manufacturer's instructions and approved submittal drawings .
  - 1. When manufacturer's instructions deviate from specifications, submit proposed resolution for Contracting Officer's Representative consideration.
- B. Comply with NRCA Manual installation requirements.
- C. Comply with UL 580 for uplift resistance.
- D. Do not allow membrane and flashing to contact surfaces contaminated with asphalt, coal tar, oil, grease, or other substances incompatible with EPDM.

### **3.5 ROOFING INSTALLATION**

- A. Install membrane perpendicular to long dimension of insulation boards.
- B. Begin membrane installation at roof low point and work towards high point. Lap membrane shingled in water flow direction.
- C. Position membrane free of buckles and wrinkles.
- D. Roll membrane out; inspect for defects as membrane is unrolled. Remove defective areas:
  - 1. Allow 30 minutes for membrane to relax before proceeding.
  - 2. Lap edges and ends minimum 75 mm (3 inches). Clean lap surfaces.
  - 3. Install seam adhesive or tape, unless furnished with factory applied adhesive strips. Apply pressure to develop full adhesion.
  - 4. Check seams to ensure continuous adhesion and correct defects.
  - 5. Finish seam edges with beveled bead of lap sealant.
  - 6. Finish seams same day as membrane is installed.
  - 7. Anchor membrane perimeter to roof deck and parapet wall as indicated on drawings.
- E. Membrane Perimeter Anchorage:
  - 1. Install batten with fasteners at perimeter of each roof area, curb flashing, expansion joints and similar penetrations on top of roof membrane as indicated on drawings.

F. Adhered System Installation:

1. Apply bonding adhesive in quantities required by roofing membrane manufacturer.
2. Fold sheet back on itself, clean and coat the bottom side of the membrane and the top of substrate with adhesive. Do not coat the lap joint area.
3. After adhesive has set according to adhesive manufacturer's instructions, roll roofing membrane into adhesive minimizing voids and wrinkles.
4. Repeat for other half of sheet.
5. Cut voids and wrinkles to lay flat. Clean and patch cut area.

**3.6 FLASHING INSTALLATION**

- A. Install flashings on same day as roofing membrane is installed. When flashing cannot be completely installed in one day, complete installation until flashing is watertight and provide temporary covers or seals.
- B. Flashing Roof Drains:
1. Install roof drain flashing according to roofing membrane manufacturer's instructions.
    - a. Coordinate to set the metal drain flashing in asphalt roof cement, holding cement back from the edge of the metal flange.
    - b. Do not allow roof cement to contact EPDM roofing membrane.
    - c. Adhere roofing membrane to metal flashing with bonding adhesive.
  2. Turn metal drain flashing and roofing membrane down into drain body. Install clamping ring and strainer.
- C. Installing Base Flashing and Pipe Flashing:
1. Install flashing sheet to pipes, walls and curbs to minimum 200 mm (8 inches) height above roof surfaces and extend roofing manufacturer's standard lap dimension onto roofing membranes.
    - a. Adhere flashing with bonding adhesive.
    - b. Form inside and outside corners of flashing sheet according to NRCA Manual. Form pipe flashing according to NRCA Manual.
    - c. Lap ends roofing manufacturer's standard dimension.
    - d. Adhesively splice flashing sheets together, and adhesively splice flashing sheets to roofing membranes. Finish exposed edges with lap sealant.
  2. Anchor top of flashing to walls and curbs with fasteners spaced maximum 150 mm (6 inches) on center. Use surface mounted fastening strip with sealant on ducts. Use pipe clamps on pipes or other round penetrations.
  3. Apply sealant to top edge of flashing.
- D. Installing Building Expansion Joints:
1. Install base flashing on curbs as specified.
  2. Coordinate installation with metal expansion joint cover



3. Install flexible tubing 1-1/2 times width of joint centered over joint. Cover tubing with flashing sheet adhered to base flashing and lapping base flashing roofing manufacturer's standard dimension. Finish edges of laps with lap sealant.
- E. Repairs to Membrane and Flashings:
1. Remove sections of roofing membrane or flashing sheet that are creased, wrinkled, or fishmouthed.
  2. Cover removed areas, cuts and damaged areas with patch extending 100 mm (4 inches) beyond damaged, cut, or removed area. Adhesively splice patch to roofing membrane or flashing sheet. Finish edge of lap with lap sealant.

### **3.7 FIELD QUALITY CONTROL**

- A. Field Tests: Performed by testing laboratory specified in Section 01 45 29, TESTING LABORATORY SERVICES.
1. Examine and probe roofing membrane and flashing seams in presence of Contracting Officer's Representative and Manufacturer's field representative.
  2. Probe seams to detect marginal bonds, voids, skips, and fishmouths.
  3. Cut 100 mm (4 inch) wide by 300 mm (12 inch) long samples through seams where directed by Contracting Officer's Representative.
  4. Cut one sample for every 450 m (1500 feet) of seams.
  5. Cut samples perpendicular to seams.
  6. Failure of samples to pass ASTM D1876 test will be cause for rejection of work.
  7. Repair areas where samples are taken and where marginal bond, voids, and skips occur.
  8. Repair fishmouths and wrinkles by cutting to lay flat. Install patch over cut area extending 100 mm (4 inches) beyond cut.
- B. Manufacturer Services:
1. Inspect initial installation, installation in progress, and completed work.
  2. Issue supplemental installation instructions necessitated by field conditions.
  3. Prepare and submit inspection reports.
  4. Certify completed installation complies with manufacturer's instructions and warranty requirements.

### **3.8 CLEANING**

- A. Remove excess adhesive before adhesive sets.
- B. Clean exposed roofing surfaces. Remove contaminants and stains to comply with specified solar reflectance performance.

### **3.9 PROTECTION**

- A. Protect roofing system from traffic and construction operations.

1. Protect roofing system when used for subsequent work platform, materials storage, or staging.
  2. Distribute scaffolding loads to exert maximum 50 percent roofing system materials compressive strength.
- B. Loose lay temporary insulation board overlaid with plywood or OSB.
1. Weight boards to secure against wind uplift.
- C. Remove protection when no longer required .
- D. Repair damage.

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**SECTION 07 60 00**  
**FLASHING AND SHEET METAL**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

Formed sheet metal work for wall and roof flashing, copings, roof edge metal, fasciae, drainage specialties, and formed expansion joint covers are specified in this section.

**1.2 RELATED WORK**

- A. Membrane base flashings and stripping: Section 07 53 23 EPDM Roofing.
- B. Flashing components of factory finished roofing and wall systems: Division 07 roofing and wall system sections.
- C. Joint Sealants: Section 07 92 00, JOINT SEALANTS.
- D. Integral flashing components of manufactured roof specialties and accessories or equipment: Section 07 72 00, ROOF ACCESSORIES.
- E. Paint materials and application: Section 09 91 00, PAINTING.

**1.3 APPLICABLE PUBLICATIONS**

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only. Editions of applicable publications current on date of issue of bidding documents apply unless otherwise indicated.
- B. Aluminum Association (AA):
  - AA-C22A41 .....Aluminum Chemically etched medium matte, with clear anodic coating, Class I Architectural, 0.7-mil thick
  - AA-C22A42 .....Chemically etched medium matte, with integrally colored anodic coating, Class I Architectural, 0.7 mils thick
  - AA-C22A44 .....Chemically etched medium matte with electrolytically deposited metallic compound, integrally colored coating Class I Architectural, 0.7-mil thick finish
- C. American National Standards Institute/Single-Ply Roofing Institute (ANSI/SPRI):
  - ANSI/SPRI ES-1-03 .....Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems
- D. American Architectural Manufacturers Association (AAMA):
  - AAMA 620 .....Voluntary Specification for High Performance Organic Coatings on Coil Coated Architectural Aluminum
  - AAMA 621 .....Voluntary Specification for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) and Zinc-Aluminum Coated Steel Substrates

E. ASTM International (ASTM):

- A240/A240M-14 ..... Standard Specification for Chromium and Chromium-Nickel  
Stainless Steel Plate, Sheet and Strip for Pressure Vessels and  
for General Applications.
- A653/A653M-11 ..... Steel Sheet Zinc-Coated (Galvanized) or Zinc Alloy Coated  
(Galvanized) by the Hot- Dip Process
- B32-08..... Solder Metal
- B209-10..... Aluminum and Aluminum-Alloy Sheet and Plate
- B370-12..... Copper Sheet and Strip for Building Construction
- D173-03(R2011) ..... Bitumen-Saturated Cotton Fabrics Used in Roofing and  
Waterproofing
- D412-06(R2013) ..... Vulcanized Rubber and Thermoplastic Elastomers-Tension
- D1187-97(R2011) ..... Asphalt Base Emulsions for Use as Protective Coatings for Metal
- D1784-11 ..... Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated  
Poly (Vinyl Chloride) (CPVC) Compounds
- D3656-07 ..... Insect Screening and Louver Cloth Woven from Vinyl-Coated  
Glass Yarns
- D4586-07 ..... Asphalt Roof Cement, Asbestos Free

F. Sheet Metal and Air Conditioning Contractors National Association (SMACNA): Architectural  
Sheet Metal Manual.

G. National Association of Architectural Metal Manufacturers (NAAMM):

- AMP 500-06 ..... Metal Finishes Manual

H. Federal Specification (Fed. Spec):

- A-A-1925A..... Shield, Expansion; (Nail Anchors)
- UU-B-790A..... Building Paper, Vegetable Fiber

I. International Code Commission (ICC): International Building Code, Current Edition

## 1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND  
SAMPLES.
- B. Shop Drawings: For all specified items, including:
1. Flashings
  2. Copings
  3. Gravel Stop-Fascia
  4. Gutter and Conductors
  5. Expansion joints
  6. Fascia-cant
- C. Manufacturer's Literature and Data: For all specified items, including:

1. Two-piece counterflashing
  2. Thru wall flashing
  3. Expansion joint cover, each type
  4. Nonreinforced, elastomeric sheeting
  5. Copper clad stainless steel
  6. Polyethylene coated copper
  7. Bituminous coated copper
  8. Copper covered paper
  9. Fascia-cant
- D. Certificates: Indicating compliance with specified finishing requirements, from applicator and contractor.

## **PART 2 - PRODUCTS**

### **2.1 FLASHING AND SHEET METAL MATERIALS**

- A. Stainless Steel: ASTM A240, Type 302B, dead soft temper.
- B. Copper ASTM B370, cold-rolled temper.
- C. Bituminous Coated Copper: Minimum copper ASTM B370, weight not less than 1 kg/m<sup>2</sup> (3 oz/sf). Bituminous coating shall weigh not less than 2 kg/m<sup>2</sup> (6 oz/sf); or, copper sheets may be bonded between two layers of coarsely woven bitumen-saturated cotton fabric ASTM D173. Exposed fabric surface shall be crimped.
- D. Aluminum Sheet: ASTM B209, alloy 3003-H14 except alloy used for color anodized aluminum shall be as required to produce specified color. Alloy required to produce specified color shall have the same structural properties as alloy 3003-H14.
- E. Galvanized Sheet: ASTM, A653.
- F. Nonreinforced, Elastomeric Sheeting: Elastomeric substances reduced to thermoplastic state and extruded into continuous homogenous sheet (0.056 inch) thick. Sheeting shall have not less than 7 MPa (1,000 psi) tensile strength and not more than seven percent tension-set at 50 percent elongation when tested in accordance with ASTM D412. Sheeting shall show no cracking or flaking when bent through 180 degrees over a 1 mm (1/32 inch) diameter mandrel and then bent at same point over same size mandrel in opposite direction through 360 degrees at temperature of -30°C (-20 °F).

### **2.2 FLASHING ACCESSORIES**

- A. Solder: ASTM B32; flux type and alloy composition as required for use with metals to be soldered.
- B. Rosin Paper: Fed-Spec. UU-B-790, Type I, Grade D, Style 1b, Rosin-sized sheathing paper, weighing approximately 3 Kg/10 m<sup>2</sup> ( 6 lbs/100 sf).

- C. Bituminous Paint: ASTM D1187, Type I.
- D. Fasteners:
  - 1. Use copper, copper alloy, bronze, brass, or stainless steel for copper and copper clad stainless steel, and stainless steel for stainless steel and aluminum alloy. Use galvanized steel or stainless steel for galvanized steel.
  - 2. Nails:
    - a. Minimum diameter for copper nails: 3 mm (0.109 inch).
    - b. Minimum diameter for aluminum nails 3 mm (0.105 inch).
    - c. Minimum diameter for stainless steel nails: 2 mm (0.095 inch) and annular threaded.
    - d. Length to provide not less than 22 mm (7/8 inch) penetration into anchorage.
  - 3. Rivets: Not less than 3 mm (1/8 inch) diameter.
  - 4. Expansion Shields: Fed Spec A-A-1925A.
- E. Sealant: As specified in Section 07 92 00, JOINT SEALANTS for exterior locations.
- F. Insect Screening: ASTM D3656, 18 by 18 regular mesh.
- G. Roof Cement: ASTM D4586.

## **2.3 SHEET METAL THICKNESS**

- A. Except as otherwise shown or specified use thickness or weight of sheet metal as follows:
- B. Concealed Locations (Built into Construction):
  - 1. Copper: 30g (10 oz) minimum 0.33 mm (0.013 inch thick).
  - 2. Stainless steel: 0.25 mm (0.010 inch) thick.
  - 3. Galvanized steel: 0.5 mm (0.021 inch) thick.
- C. Exposed Locations:
  - 1. Copper: 0.4 Kg (16 oz).
  - 2. Stainless steel: 0.4 mm (0.015 inch).
- D. Thickness of aluminum or galvanized steel is specified with each item.

## **2.4 FABRICATION, GENERAL**

- A. Jointing:
  - 1. In general, copper, stainless steel and copper clad stainless steel joints, except expansion and contraction joints, shall be locked and soldered.
  - 2. Jointing of copper over 0.5 Kg (20 oz) weight or stainless steel over 0.45 mm (0.018 inch) thick shall be done by lapping, riveting and soldering.
  - 3. Joints shall conform to following requirements:
    - a. Flat-lock joints shall finish not less than 19 mm (3/4 inch) wide.
    - b. Lap joints subject to stress shall finish not less than 25 mm (one inch) wide and shall be soldered and riveted.
    - c. Unsoldered lap joints shall finish not less than 100 mm (4 inches) wide.

4. Flat and lap joints shall be made in direction of flow.
  5. Edges of bituminous coated copper, copper covered paper, nonreinforced elastomeric sheeting and polyethylene coated copper shall be jointed by lapping not less than 100 mm (4 inches) in the direction of flow and cementing with asphalt roof cement or sealant as required by the manufacturer's printed instructions.
  6. Soldering:
    - a. Pre tin both mating surfaces with solder for a width not less than 38 mm (1 1/2 inches) of uncoated copper, stainless steel, and copper clad stainless steel.
    - b. Wire brush to produce a bright surface before soldering lead coated copper.
    - c. Treat in accordance with metal producers recommendations other sheet metal required to be soldered.
    - d. Completely remove acid and flux after soldering is completed.
- B. Expansion and Contraction Joints:
1. Fabricate in accordance with the Architectural Sheet Metal Manual recommendations for expansion and contraction of sheet metal work in continuous runs.
  2. Space joints as shown or as specified.
  3. Space expansion and contraction joints for copper, stainless steel, and copper clad stainless steel at intervals not exceeding 7200 mm (24 feet).
  4. Space expansion and contraction joints for aluminum at intervals not exceeding 5400 mm (18 feet), except do not exceed 3000 mm (10 feet) for gravel stops and fascia-cant systems.
  5. Fabricate slip-type or loose locked joints and fill with sealant unless otherwise specified.
  6. Fabricate joint covers of same thickness material as sheet metal served.
- C. Cleats:
1. Fabricate cleats to secure flashings and sheet metal work over 300 mm (12 inches) wide and where specified.
  2. Provide cleats for maximum spacing of 300 mm (12 inch) centers unless specified otherwise.
  3. Form cleats of same metal and weights or thickness as the sheet metal being installed unless specified otherwise.
  4. Fabricate cleats from 50 mm (2 inch) wide strip. Form end with not less than 19 mm (3/4 inch) wide loose lock to item for anchorage. Form other end of length to receive nails free of item to be anchored and end edge to be folded over and cover nail heads.
- D. Edge Strips or Continuous Cleats:
1. Fabricate continuous edge strips where shown and specified to secure loose edges of the sheet metal work.
  2. Except as otherwise specified, fabricate edge strips or minimum 1.25 mm (0.050 inch) thick aluminum.
  3. Use material compatible with sheet metal to be secured by the edge strip.

4. Fabricate in 3000 mm (10 feet) maximum lengths with not less than 19 mm (3/4 inch) loose lock into metal secured by edge strip.
5. Fabricate Strips for fascia anchorage to extend below the supporting wood construction to form a drip and to allow the flashing to be hooked over the lower edge at least 19 mm (3/4-inch).
6. Fabricate anchor edge maximum width of 75 mm (3 inches) or of sufficient width to provide adequate bearing area to insure a rigid installation using 1.6 mm (0.0625 inch) thick aluminum.

E. Drips:

1. Form drips at lower edge of sheet metal counter-flashings (cap flashings), fascias, gravel stops, wall copings, by folding edge back 13 mm (1/2 inch) and bending out 45 degrees from vertical to carry water away from the wall.
2. Form drip to provide hook to engage cleat or edge strip for fastening for not less than 19 mm (3/4 inch) loose lock where shown.

F. Edges:

1. Edges of flashings concealed in masonry joints opposite drain side shall be turned up 6 mm (1/4 inch) to form dam, unless otherwise specified or shown otherwise.
2. Finish exposed edges of flashing with a 6 mm (1/4 inch) hem formed by folding edge of flashing back on itself when not hooked to edge strip or cleat. Use 6 mm (1/4 inch) minimum penetration beyond wall face with drip for through-wall flashing exposed edge.
3. All metal roof edges shall meet requirements of IBC, current edition.

G. Metal Options:

1. Where options are permitted for different metals use only one metal throughout.
2. Stainless steel may be used in concealed locations for fasteners of other metals exposed to view.
3. Where copper gravel stops, copings and flashings will carry water onto cast stone, stone, or architectural concrete, or stainless steel.

## 2.5 FINISHES

- A. Use same finish on adjacent metal or components and exposed metal surfaces unless specified or shown otherwise.
- B. In accordance with NAAMM Metal Finishes Manual AMP 500, unless otherwise specified.
- C. Finish exposed metal surfaces as follows, unless specified otherwise:
  1. Copper: Mill finish.
  2. Stainless Steel: Finish No. 2B or 2D.
  3. Aluminum:
    - a. Clear Finish: AA-C22A41 medium matte, clear anodic coating, Class 1 Architectural, 18 mm (0.7 mils) thick.



- b. Colored Finish: AA-C22A42 (anodized) or AA-C22A44 (electrolytically deposited metallic compound) medium matte, integrally colored coating, Class 1 Architectural, 18 mm (0.7 mils) thick. Dyes will not be accepted.
  - c. Fluorocarbon Finish: AAMA 620, high performance organic coating.
  - d. Mill finish.
4. Steel and Galvanized Steel:
- a. Finish painted under Section 09 91 00, PAINTING unless specified as prefinished item.
  - b. Manufacturer's finish:
    - 1) Baked on prime coat over a phosphate coating.
    - 2) Baked-on prime and finish coat over a phosphate coating.
    - 3) Fluorocarbon Finish: AAMA 621, high performance organic coating.

## 2.6 THROUGH-WALL FLASHINGS

- A. Form through-wall flashing to provide a mechanical bond or key against lateral movement in all directions. Install a sheet having 2 mm (1/16 inch) deep transverse channels spaced four to every 25 mm (one inch), or ribbed diagonal pattern, or having other deformation unless specified otherwise.
  - 1. Fabricate in not less than 2400 mm (8 feet) lengths; 3000 mm (10 feet) maximum lengths.
  - 2. Fabricate so keying nests at overlaps.
- B. For Masonry Work When Concealed Except for Drip:
  - 1. Either copper, stainless steel, or copper clad stainless steel.
  - 2. Form an integral dam at least 5 mm (3/16 inch) high at back edge.
  - 3. Form exposed portions of flashing with drip, approximately 6 mm (1/4 inch) projection beyond wall face.
- C. For Masonry Work When Exposed Edge Forms a Receiver for Counter Flashing:
  - 1. Use same metal and thickness as counter flashing.
  - 2. Form an integral dam at least 5 mm (3/16 inch) high at back edge.
  - 3. Form exposed portion as snap lock receiver for counter flashing upper edge.
- D. For Flashing at Architectural Precast Concrete Panels or Stone Panels.
  - 1. Use plan flat sheet of stainless steel.
  - 2. Form exposed portions with drip as specified or receiver.
- E. Window Sill Flashing and Lintel Flashing:
  - 1. Use either copper, stainless steel, copper clad stainless steel plane flat sheet, or nonreinforced elastomeric sheeting, bituminous coated copper, copper covered paper, or polyethylene coated copper.
  - 2. Fabricate flashing at ends with folded corners to turn up 5 mm (3/16 inch) in first vertical masonry joint beyond masonry opening.
  - 3. Turn up back edge as shown.

4. Form exposed portion with drip as specified or receiver.
- F. Door Sill Flashing:
1. Where concealed, use either 0.5 Kg (20 oz) copper, 0.5 mm (0.018 inch) thick stainless steel, or 0.5 mm (0.018 inch) thick copper clad stainless steel.
  2. Where shown on drawings as combined counter flashing under threshold, sill plate, door sill, or where subject to foot traffic, use either 0.6 Kg (24 ounce) copper, 0.6 mm (0.024 inch) stainless steel, or 0.6 mm (0.024 inch) thick stainless steel.
  3. Fabricate flashing at ends to turn up 5 mm (3/16 inch) in first vertical masonry joint beyond masonry opening with folded corners.

## **2.7 BASE FLASHING**

- A. Use metal base flashing at vertical surfaces intersecting built-up roofing without cant strips or where shown.
1. Use either copper, or stainless steel, thickness specified unless specified otherwise.
  2. When flashing is over 250 mm (10 inches) in vertical height or horizontal width use either 0.5 Kg (20 oz) copper or 0.5 mm (0.018 inch) stainless steel.
  3. Use stainless steel at aluminum roof curbs where flashing contacts the aluminum.
  4. Use either copper, or stainless steel at pipe flashings.
- B. Fabricate metal base flashing up vertical surfaces not less than 200 mm (8 inch) nor more than 400 mm (16 inch).
- C. Fabricate roof flange not less than 100 mm (4 inches) wide unless shown otherwise. When base flashing length exceeds 2400 mm (8 feet) form flange edge with 13 mm (1/2 inch) hem to receive cleats.
- D. Form base flashing bent from strip except pipe flashing. Fabricate ends for riveted soldered lap seam joints. Fabricate expansion joint ends as specified.
- E. Pipe Flashing: (Other than engine exhaust or flue stack)
1. Fabricate roof flange not less than 100 mm (4 inches) beyond sleeve on all sides.
  2. Extend sleeve up and around pipe and flange out at bottom not less than 13 mm (1/2 inch) and solder to flange and sleeve seam to make watertight.
  3. At low pipes 200 mm (8 inch) to 450 mm (18 inch) above roof:
    - a. Form top of sleeve to turn down into the pipe at least 25 mm (one inch).
    - b. Allow for loose fit around and into the pipe.
  4. At high pipes and pipes with goosenecks or other obstructions which would prevent turning the flashing down into the pipe:
    - a. Extend sleeve up not less than 300 mm (12 inch) above roofing.
    - b. Allow for loose fit around pipe.

## **2.8 COUNTERFLASHING (CAP FLASHING OR HOODS)**

- A. Either copper or stainless steel, unless specified otherwise.
- B. Fabricate to lap base flashing a minimum of 100 mm (4 inches) with drip:
  - 1. Form lock seams for outside corners. Allow for lap joints at ends and inside corners.
  - 2. In general, form flashing in lengths not less than 2400 mm (8 feet) and not more than 3000 mm (10 feet).
  - 3. Two-piece, lock in type flashing may be used in-lieu-of one piece counter-flashing.
  - 4. Manufactured assemblies may be used.
  - 5. Where counterflashing is installed at new work use an integral flange at the top designed to be extended into the masonry joint or reglet in concrete.
  - 6. Where counterflashing is installed at existing work use surface applied type, formed to provide a space for the application of sealant at the top edge.
- C. One-piece Counterflashing:
  - 1. Back edge turned up and fabricate to lock into reglet in concrete.
  - 2. Upper edge formed to extend full depth of masonry unit in mortar joint with back edge turned up 6 mm (1/4 inch).
- D. Two-Piece Counterflashing:
  - 1. Receiver to extend into masonry wall depth of masonry unit with back edge turned up 6 mm (1/4 inch) and exposed edge designed to receive and lock counterflashing upper edge when inserted.
  - 2. Counterflashing upper edge designed to snap lock into receiver.
- E. Surface Mounted Counterflashing; one or two piece:
  - 1. Use at existing or new surfaces where flashing can not be inserted in vertical surface.
  - 2. One piece fabricate upper edge folded double for 65 mm (2 1/2 inches) with top 19 mm (3/4 inch) bent out to form "V" joint sealant pocket with vertical surface. Perforate flat double area against vertical surface with horizontally slotted fastener holes at 400 mm (16 inch) centers between end holes. Option: One piece surface mounted counter-flashing (cap flashing) may be used. Fabricate as detailed on Plate 51 of SMACNA Architectural Sheet Metal Manual.
  - 3. Two pieces: Fabricate upper edge to lock into surface mounted receiver. Fabricate receiver joint sealant pocket on upper edge and lower edge to receive counterflashing, with slotted fastener holes at 400 mm (16 inch) centers between upper and lower edge.
- F. Pipe Counterflashing:
  - 1. Form flashing for water-tight umbrella with upper portion against pipe to receive a draw band and upper edge to form a "V" joint sealant receiver approximately 19 mm (3/4 inch) deep.
  - 2. Fabricate 100 mm (4 inch) over lap at end.
  - 3. Fabricate draw band of same metal as counter flashing. Use 0.6 Kg (24 oz) copper or 0.33 mm (0.013 inch) thick stainless steel or copper coated stainless steel.

4. Use stainless steel bolt on draw band tightening assembly.
  5. Vent pipe counter flashing may be fabricated to omit draw band and turn down 25 mm (one inch) inside vent pipe.
- G. Where vented edge decks intersect vertical surfaces, form in one piece, shape to slope down to a point level with and in front of edge-set notched plank; then, down vertically, overlapping base flashing.

## **2.9 REGLETS**

- A. Fabricate reglets of one of the following materials:
1. 0.4 Kg (16 ounce) copper.
  2. Stainless steel, not less than 0.3 mm (0.012 inch) thick.
- B. Fill open-type reglets with fiberboard or other suitable separator, to prevent crushing of the slot during installation.
- C. Fabricate reglets for building into horizontal masonry mortar joints not less than 19 mm (3/4 inch) deep, nor more than 25 mm (one inch) deep.
- D. Fabricate mitered corners, fittings, and special shapes as may be required by details.

## **2.10 INSULATED EXPANSION JOINT COVERS**

- A. Either type optional, use only one type throughout.
- B. Types:
1. Construct of two preformed, stainless steel strips, not less than 0.4 mm (0.015 inch) thick, mechanically and adhesively bonded to both sides of a 2 mm (1/16 inch) thick neoprene or butyl sheet, or to a 0.4 mm (32 mil) thick reinforced chlorinated polyethylene sheet.  
Adhesively attach a 10 mm (3/8 inch) thick sheet of closed cell, neoprene foam insulation, to the underside of the neoprene, butyl, or chlorinated polyethylene sheet.
  2. Constructed of a 2 mm (1/16 inch) thick vinyl sheet, flanged at both sides with stainless steel strips not less than 0.4 mm (0.015 inch) thick. Vinyl sheet locked and encased by the stainless steel strip and prepunched for nailing. A 10 mm (3/8 inch) thick closed cell polyvinyl chloride foam insulating strip shall be heat laminated to the underside of the vinyl sheet between the stainless steel strips.
- C. Expansion joint covers shall have factory fabricated mitered corners, crossing tees, and other necessary accessories. Furnish in the longest available lengths.
- D. Metal flange of sufficient width to extend over the top of the curb and down curb sides 50 mm (2 inches) with hemmed edge for lock to edge strip.

## **2.11 SCUPPERS**

- A. Fabricate scuppers with minimum of 100 mm (4 inch) wide flange.
- B. Provide flange at top on through wall scupper to extend to top of base flashing.

- C. Fabricate exterior wall side to project not less than 13 mm (1/2 inch) beyond face of wall with drip at bottom outlet edge.
- D. Fabricate not less than 100 mm (4 inch) wide flange to lap behind gravel stop fascia.
- E. Fabricate exterior wall flange for through wall scupper not less than 25 mm (one inch) wide on top and sides with edges hemmed.
- F. Fabricate gravel stop bar of 25 mm x 25 mm (one by one inch) angle strip soldered to bottom of scupper.
- G. Fabricate scupper not less than 200 mm (8 inch) wide and not less than 125 mm (5 inch) high for through wall scupper.
- H. Solder joints watertight.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. General:
  - 1. Install flashing and sheet metal items as shown in Sheet Metal and Air Conditioning Contractors National Association, Inc., publication, ARCHITECTURAL SHEET METAL MANUAL, except as otherwise shown or specified.
  - 2. Apply Sealant as specified in Section 07 92 00, JOINT SEALANTS.
  - 3. Apply sheet metal and other flashing material to surfaces which are smooth, sound, clean, dry and free from defects that might affect the application.
  - 4. Remove projections which would puncture the materials and fill holes and depressions with material compatible with the substrate. Cover holes or cracks in wood wider than 6 mm (1/4 inch) with sheet metal compatible with the roofing and flashing material used.
  - 5. Coordinate with masonry work for the application of a skim coat of mortar to surfaces of unit masonry to receive flashing material before the application of flashing.
  - 6. Apply a layer of 7 Kg (15 pound) saturated felt followed by a layer of rosin paper to wood surfaces to be covered with copper. Lap each ply 50 mm (2 inch) with the slope and nail with large headed copper nails.
  - 7. Confine direct nailing of sheet metal to strips 300 mm (12 inch) or less wide. Nail flashing along one edge only. Space nail not over 100 mm (4 inches) on center unless specified otherwise.
  - 8. Install bolts, rivets, and screws where indicated, specified, or required in accordance with the SMACNA Sheet Metal Manual. Space rivets at 75 mm (3 inch) on centers in two rows in a staggered position. Use neoprene washers under fastener heads when fastener head is exposed.
  - 9. Coordinate with roofing work for the installation of metal base flashings and other metal items having roof flanges for anchorage and watertight installation.

10. Nail continuous cleats on 75 mm (3 inch) on centers in two rows in a staggered position.
11. Nail individual cleats with two nails and bend end tab over nail heads. Lock other end of cleat into hemmed edge.
12. Install flashings in conjunction with other trades so that flashings are inserted in other materials and joined together to provide a water tight installation.
13. Where required to prevent galvanic action between dissimilar metal isolate the contact areas of dissimilar metal with sheet lead, waterproof building paper, or a coat of bituminous paint.
14. Isolate aluminum in contact with dissimilar metals others than stainless steel, white bronze or other metal compatible with aluminum by:
  - a. Paint dissimilar metal with a prime coat of zinc-chromate or other suitable primer, followed by two coats of aluminum paint.
  - b. Paint dissimilar metal with a coat of bituminous paint.
  - c. Apply an approved caulking material between aluminum and dissimilar metal.
15. Paint aluminum in contact with or built into mortar, concrete, plaster, or other masonry materials with a coat of bituminous paint.
16. Paint aluminum in contact with absorptive materials that may become repeatedly wet with two coats of bituminous paint or two coats of aluminum paint.

### **3.2 THROUGH-WALL FLASHING**

A. General:

1. Install continuous through-wall flashing between top of concrete foundation walls and bottom of masonry building walls; at top of concrete floors; under masonry, concrete, or stone copings and elsewhere as shown.
2. Where exposed portions are used as a counterflashings, lap base flashings at least 100 mm (4 inches) and use thickness of metal as specified for exposed locations.
3. Exposed edge of flashing may be formed as a receiver for two piece counter flashing as specified.
4. Terminate exterior edge beyond face of wall approximately 6 mm (1/4 inch) with drip edge where not part of counter flashing.
5. Turn back edge up 6 mm (1/4 inch) unless noted otherwise where flashing terminates in mortar joint or hollow masonry unit joint.
6. Terminate interior raised edge in masonry backup unit approximately 38 mm (1 1/2 inch) into unit unless shown otherwise.
7. Under copings terminate both edges beyond face of wall approximately 6 mm (1/4 inch) with drip edge.
8. Lap end joints at least two corrugations, but not less than 100 mm (4 inches). Seal laps with sealant.

9. Where dowels, reinforcing bars and fastening devices penetrate flashing, seal penetration with sealing compound. Sealing compound is specified in Section 07 92 00, JOINT SEALANTS.
10. Coordinate with other work to set in a bed of mortar above and below flashing so that total thickness of the two layers of mortar and flashing are same as regular mortar joint.
11. Where ends of flashing terminate turn ends up 25 mm (1 inch) and fold corners to form dam extending to wall face in vertical mortar or veneer joint.
12. Turn flashing up not less than 200 mm (8 inch) between masonry or behind exterior veneer.
13. When flashing terminates in reglet extend flashing full depth into reglet and secure with lead or plastic wedges spaced 150 mm (6 inch) on center.
14. Continue flashing around columns:
  - a. Where flashing cannot be inserted in column reglet hold flashing vertical leg against column.
  - b. Counterflash top edge with 75 mm (3 inch) wide strip of saturated cotton unless shown otherwise. Secure cotton strip with roof cement to column. Lap base flashing with cotton strip 38 mm (1 1/2 inch).
- B. Flashing at Top of Concrete Foundation Walls Where concrete is exposed. Turn up not less than 200 mm (8 inch) high and into masonry backup mortar joint or reglet in concrete backup as specified.
- C. Flashing at Cavity Wall Construction: Where flashing occurs in cavity walls turn vertical portion up against backup under waterproofing, if any, into mortar joint. Turn up over insulation, if any, and horizontally through insulation into mortar joint.
- D. Flashing at Veneer Walls:
  1. Install near line of finish floors over shelf angles or where shown.
  2. Turn up against sheathing.
  3. At stud framing, hem top edge 19 mm (3/4 inch) and secure to each stud with stainless steel fasteners through sheathing.
  4. At concrete backing, extend flashing into reglet as specified.
  5. Coordinate with installation of waterproofing or asphalt felt for lap over top of flashing.
- E. Lintel Flashing when not part of shelf angle flashing:
  1. Install flashing full length of lintel to nearest vertical joint in masonry over veneer.
  2. Turn ends up 25 mm (one inch) and fold corners to form dam and extend end to face of wall.
  3. Turn back edge up to top of lintel; terminate back edge as specified for back-up wall.
- F. Window Sill Flashing:
  1. Install flashing to extend not less than 100 mm (4 inch) beyond ends of sill into vertical joint of masonry or veneer.
  2. Turn back edge up to terminate under window frame.

3. Turn ends up 25 mm (one inch) and fold corners to form dam and extend to face of wall.

G. Door Sill Flashing:

1. Install flashing under bottom of plate sills of doors over curbs opening onto roofs. Extend flashing out to form counter flashing or receiver for counter flashing over base flashing. Set in sealant.
2. Extend sill flashing 200 mm (8 inch) beyond jamb opening. Turn ends up one inch in vertical masonry joint, extend end to face of wall. Join to counter flashing for water tight joint.
3. Where doors thresholds cover over waterproof membranes install sill flashing over water proof membrane under thresholds. Extend beyond opening to cover exposed portion of waterproof membrane and not less than 150 mm (6 inch) beyond door jamb opening at ends. Turn up approximately 6 mm (1/4 inch) under threshold.

### 3.3 BASE FLASHING

- A. Install where roof membrane type base flashing is not used and where shown.
1. Install flashing at intersections of roofs with vertical surfaces or at penetrations through roofs, to provide watertight construction.
  2. Install metal flashings and accessories having flanges extending out on top of the built-up roofing before final bituminous coat and roof aggregate is applied.
  3. Set flanges in heavy trowel coat of roof cement and nail through flanges into wood nailers over bituminous roofing.
  4. Secure flange by nailing through roofing into wood blocking with nails spaced 75 mm (3 inch) on centers or, when flange over 100 mm (4 inch) wide terminate in a 13 mm (1/2 inch) folded edge anchored with cleats spaced 200 mm (8 inch) on center. Secure one end of cleat over nail heads. Lock other end into the seam.
- B. For long runs of base flashings install in lengths of not less than 2400 mm (8 feet) nor more than 3000 mm (ten feet). Install a 75 mm (3 inch) wide slip type, loose lock expansion joint filled with sealant in joints of base flashing sections over 2400 mm (8 feet) in length. Lock and solder corner joints at corners.
- C. Extend base flashing up under counter flashing of roof specialties and accessories or equipment not less than 75 mm (3 inch).

### 3.4 COUNTERFLASHING (CAP FLASHING OR HOODS)

- A. General:
1. Install counterflashing over and in conjunction with installation of base flashings, except as otherwise specified or shown.
  2. Install counterflashing to lap base flashings not less than 100 mm (4 inch).
  3. Install upper edge or top of counterflashing not less than 225 mm (9 inch) above top of the roofing.



4. Lap joints not less than 100 mm (4 inch). Stagger joints with relation to metal base flashing joints.
  5. Use surface applied counterflashing on existing surfaces and new work where not possible to integrate into item.
  6. When fastening to concrete or masonry, use screws driven in expansion shields set in concrete or masonry. Use screws to wood and sheet metal. Set fasteners in mortar joints of masonry work.
- B. One Piece Counterflashing:
1. Where flashing is installed at new masonry, coordinate to insure proper height, embed in mortar, and end lap.
  2. Where flashing is installed in reglet in concrete insert upper edge into reglet. Hold flashing in place with lead wedges spaced not more than 200 mm (8 inch) apart. Fill joint with sealant.
  3. Where flashing is surface mounted on flat surfaces.
    - a. When top edge is double folded anchor flat portion below sealant "V" joint with fasteners spaced not over 400 mm (16 inch) on center:
      - 1) Locate fasteners in masonry mortar joints.
      - 2) Use screws to sheet metal or wood.
    - b. Fill joint at top with sealant.
  4. Where flashing or hood is mounted on pipe.
    - a. Secure with draw band tight against pipe.
    - b. Set hood and secure to pipe with a one by 25 mm x 3 mm (1 x 1/8 inch) bolt on stainless steel draw band type clamp, or a stainless worm gear type clamp.
    - c. Completely fill joint at top with sealant.
- C. Two-Piece Counterflashing:
1. Where receiver is installed at new masonry coordinate to insure proper height, embed in mortar, and lap.
  2. Surface applied type receiver:
    - a. Secure to face construction in accordance, with manufacturers instructions.
    - b. Completely fill space at the top edge of receiver with sealant.
  3. Insert counter flashing in receiver in accordance with fabricator or manufacturer's instructions and to fit tight against base flashing.
- D. Where vented edge occur install so lower edge of counterflashing is against base flashing.
- E. When counter flashing is a component of other flashing install as shown.

### 3.5 REGLETS

- A. Install reglets in a manner to provide a watertight installation.
- B. Locate reglets not less than 225 mm (9 inch) nor more than 400 mm (16 inch) above roofing, and not less than 125 mm (5 inch) nor more than 325 mm (13 inch) above cant strip.

- C. Butt and align end joints of each section of reglet and securely hold in position until concrete or mortar are hardened:
  - 1. Coordinate reglets for anchorage into concrete with formwork construction.
  - 2. Coordinate reglets for masonry to locate horizontally into mortar joints.

### 3.6 COPINGS

- A. General:
  - 1. On walls topped with a wood plank, install a continuous edge strip on the front and rearedge of the plank. Lock the coping to the edge strip with a 19 mm (3/4 inch) loose lock seam.
  - 2. Where shown turn down roof side of coping and extend down over base flashing as specified for counter-flashing. Secure counter-flashing to lock strip in coping at continuous cleat.
  - 3. Install ends adjoining existing construction so as to form space for installation of sealants. Sealant is specified in Section 07 92 00, JOINT SEALANTS.
- B. Aluminum Coping:
  - 1. Install with 6 mm (1/4 inch) joint between ends of coping sections.
  - 2. Install joint covers, centered at each joint, and securely lock in place.

### 3.7 EXPANSION JOINT COVERS, INSULATED

- A. Install insulated expansion joint covers at locations shown on curbs not less than 200 mm (8 inch) high above roof surface.
- B. Install continuous edge strips of same metal as expansion joint flange, nailed at not less than 75 mm (3 inch) centers.
- C. Install insulated expansion joint covers in accordance with manufacturer's directions locking edges to edge strips.

- - - E N D - - -

**SECTION 07 71 00  
ROOF SPECIALTIES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies copings, fascias, and expansion joints.

**1.2 RELATED WORK**

- A. Sealant material and installation: Section 07 92 00, JOINT SEALANTS.
- B. General insulation: Section 07 21 13, THERMAL INSULATION
- C. Rigid insulations for roofing: Section 07 22 00, ROOF AND DECK INSULATION

**1.3 QUALITY CONTROL**

- A. All roof accessories shall be the products of manufacturers regularly engaged in producing the kinds of products specified.
- B. Each accessory type shall be the same and be made by the same manufacturer.
- C. Each accessory shall be completely assembled to the greatest extent possible before delivery to the site.

**1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Samples: Representative sample panel of color anodized aluminum not less than 100 mm X 100 mm (four by four inches), except extrusions shall be a width not less than section to be used. Sample shall show coating with integral color and texture and shall include manufacturer's identifying label.
- C. Shop Drawings: Each item specified showing design, details of construction, installation and fastenings.
- D. Manufacturer's Literature and Data: Each item specified.
- E. Certificates: Stating that aluminum has been given specified thickness of anodizing.

**1.5 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Material (ASTM):
  - B209/209M-07.....Aluminum and Aluminum Alloy-Sheet and Plate
  - B221/221M-08.....Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
  - C612-10 .....Mineral Fiber Block and Board Thermal Insulation
  - D1187-97 (R2002) .....Asphalt-Base Emulsions for Use as Protective Coatings for Metal
- C. National Association of Architectural Metal Manufacturers (NAAMM):
  - AMP 500-06 .....Metal Finishes Manual
- D. American Architectural Manufacturers Association (AAMA):

2605-11 .....High Performance Organic Coatings on Architectural Extrusions  
and Panels.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Aluminum, Extruded: ASTM B221/B221M.
- B. Aluminum Sheet: ASTM B209/B209M.
- C. Galvanized Sheet Steel: ASTM A526/A526M; G-90 coating.
- D. Insulation: ASTM C612, Class 1 or 2.
- E. Asphalt Coating: ASTM D 1187, Type I, quick setting.

### **2.2 COPINGS**

- A. Fabricate of aluminum not less than 2 mm.
- B. Turn outer edges down each face of wall as shown.
- C. Maximum lengths of 3000 mm (10 feet).
- D. Shop fabricate external and internal corners as one piece assemblies with not less than 300 mm (12 inch) leg lengths.
- E. Provide 100 mm (four inch) wide 0.8 mm (0.032 inch) thick watertight joint covers.
- F. Provide anchor gutter bar of 0.8 mm (0.032 inch) thick with anchor holes formed for underside of joint.
- G. Provide concealed guttered splice plate of 0.8 mm (0.032 inch) thick with butyl or other resilient seal strips anchored to splice plate for underside of joint. Use galvanized steel anchor plate providing compression spring anchoring of coping cover.
- H. Finish: Anodized.

### **2.3 EXTRUDED ALUMINUM FASCIAS**

- A. Fabricate of aluminum not less than 2 mm (0.078 inch) thick.
- B. Turn fascia down face of wall and up above roof as shown.
- C. Maximum lengths of 3000 mm (10-feet).
- D. Shop fabricate external and internal corners as one piece assemblies with not less than 300 mm (12 inch) leg lengths.
- E. Provide 100 mm (four inch) wide 2 mm (0.078 inch) thick watertight joint covers with 150 mm (six inch) wide 0.8 mm (0.030 inch) thick underside joint flashing.
- F. Factory fabricated scupper assemblies:
  - 1. Fabricate scupper assembly with extended plates to match fascia-cant in 500 mm (20 inch) minimum lengths.
  - 2. Extend outlet opening not less than 50 mm (two inches) with drip edge.

3. Fabricate with stainless steel cores or sleeve to drain water from toe of cant and flash in to built-up roofing with 100 mm (4 inch) wide flange.

## **2.4 EXTRUDED ALUMINUM ROOF EXPANSION JOINT COVERS**

- A. Fabricate in 3000 mm (10 foot) lengths with fastener openings slotting for expansion not over 600 mm (24 inch) centers.
- B. Provide four-way expansion, for joint widths shown.
- C. Mill finish on aluminum.
- D. Form waterstop or moisture seals of continuous sheets of neoprene, not less than 0.8 mm (0.032 inch) thick.
- E. Fabricate corners as one piece assembly with mitered and welded joint and least dimension legs not less than 300 mm (12 inches) long.
- F. Factory fabricate end caps and transitions to insure waterproof assembly.
- G. Three piece assembly:
  1. Roof expansion joint cover system consists of an extruded aluminum cover, extruded frame or curb vertical section, galvanized steel cant, and aluminum compression clamp counter flashing, complete with moisture seals. Form cover and vertical section from extruded aluminum, 2 mm (0.080 inch) minimum thickness with spring stainless steel tension or pivot bar.
  2. Form cant from galvanized steel not less than 0.8 (0.029 inch) thick formed to profile shown.
  3. Form splice plates of not less than 0.8 mm (0.032 inch) thick aluminum sheet.
  4. Form counter flashing member of 1.3 mm (0.050 inch) thick sheet aluminum, secured with screws to the top edge of the vertical section and providing compression clamp over base flashing.
  5. Provide compression gasket separating cover from curb bearing.
- H. Two piece assembly:
  1. Roof expansion joint system consists of an extruded aluminum cover combination extruded aluminum frame or curb with integral adjustable counter flashing flange, and moisture seals.
  2. Form cover from extruded aluminum 2 mm (0.078 inch) minimum thickness.
  3. Form cover anchor system of stainless steel pivot bar.
  4. Form frame assembly of not less than 2 mm (0.076 inch) aluminum except for flashing portion.
  5. Provide compression gasket separating cover from curb at bearing.

## **2.5 FINISH**

- A. In accordance with NAAMM Amp 500-505.
- B. Aluminum, Mill Finish: AA-MIX, as fabricated.
- C. Aluminum, Clear Finish: AA-C22A41 medium matte, clear anodic coating, Class 1, Architectural, 0.7 mils thick.

- D. Aluminum Colored Finish: AA-C22A42 (anodized or AA0C22A44 (electrolytically deposited metallic compound) medium matte, integrally colored coating, Class 1, Architectural, 0.7 mils thick. Dyes will not be accepted.
- E. Fluorocarbon Finish: AAMA 2605.2 high performance organic coating.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install roof accessories where shown.
- B. Secure with fasteners in accordance with manufacture's printed installation instructions and approved shop drawings unless shown otherwise.
- C. Coordinate to install insulation where shown; see Section 07 21 13, THERMAL INSULATION and Section 07 22 00, ROOF AND DECK INSULATION.
- D. Comply with section 07 92 00, JOINT SEALANTS to install sealants where manufactures installation instructions require sealant.
- E. Coordinate with roofing work for installation of items in sequence to prevent water infiltration.
- F. Gravel Stops and Fascias:
  - 1. Install gravel stops and fascia with butt joints with approximately 6 mm (1/4 inch) space for expansion.
  - 2. Over each joint provide cover plates of sheet aluminum, complete with concealed sheet aluminum flashing, centered under each joint.
  - 3. Lap cover plates and concealed flashing over the gravel stop and fascia not less than four inches.
  - 4. Extend concealed flashing over built-up roofing, embed in roof cement and turn down over face of blocking at roof edge.
- G. Aluminum Coping:
  - 1. Install sections of coping with approximately 6 mm (1/4-inch) space between ends of sections.
  - 2. Center joint gutter bar and covers at joints and securely lock in place.
  - 3. When snap-on system is used insure front and back edges are locked in place.
- H. Expansion Joint Covers:
  - 1. Install to terminate base flashing 200 mm (8 inches) above roof.
  - 2. Install moisture seals to drain water to outlets that do not permit water to enter buildings construction.
  - 3. Use stainless steel screws when exposed.
  - 4. Three piece assembly:
    - a. Install curb section with screws to wood blocking, allowing 6 mm (1/4 inch) at butt joints between sections with splice plate at joint.

- b. Install cant to wood blocking by nailing along horizontal flange every 150 mm (6 inches), with galvanized roofing nails 25 mm (one inch) long.
  - c. After completion of base flashing install cap flashing and compression clamp and fasten to the curb or metal cant with stainless steel self-tapping screws with neoprene washers under head spaced approximately 450 mm (18 inches) on center.
  - d. Install expansion joint cover with a 6 mm (1/4 inch) wide end joints.
  - e. Install over end joint a cover plate complete with concealed aluminum flashing, centered under each joint. Fabricate flashing to lap cover not less than four inches.
5. Two piece assembly:
- a. Install curb section with screws allowing 6 mm (1/4 inch) space at end joints with splice plate at joint.
  - b. After completion of base flashing bend down cap flashing flange and secure to blocking with screws.
  - c. Install expansion joint cover with 6 mm (1/4 inch) wide space at end joints and tension bars at 600 mm (24 inches) on center.
  - d. Install cover plates with formed aluminum flashing concealed and centered on joint. Flashing to lap cover not less than 100 mm (4 inches).

### **3.2 PROTECTION OF ALUMINUM**

- A. Provide protection for aluminum against galvanic action wherever dissimilar materials are in contact, by painting the contact surfaces of the dissimilar material with two coats of asphalt coating (complete coverage), or by separating the contact surfaces with a preformed neoprene tape having pressure sensitive adhesive coating on side.
- B. Paint aluminum in contact with wood, concrete and masonry, or other absorptive materials, that may become repeatedly wet, with two coats of asphalt coating.

### **3.3 ADJUSTING**

Adjust expansion joints to close tightly and be watertight; insuring maximum allowance for building movement.

### **3.4 PROTECTION**

Protect roof accessories from damage during installation and after completion of the work from subsequent construction.

--- E N D ---

**SECTION 07 84 00  
FIRESTOPPING**

**PART 1 GENERAL**

**1.1 DESCRIPTION**

- A. Closures of openings in walls, floors and roof decks against penetration of flame, heat and smoke or gases in fire resistant rated construction.
- B. Closure of openings in walls against penetration of gases or smoke in smoke partitions.

**1.2 RELATED WORK**

- A. Sealants and application: Section 07 92 00, JOINT SEALANTS.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturers literature, data, and installation instructions for types of firestopping and smoke stopping used.
- C. List of FM, UL, or WH classification number of systems installed.
- D. Certified laboratory test reports for ASTM E814 tests for systems not listed by FM, UL, or WH proposed for use.

**1.4 DELIVERY AND STORAGE**

- A. Deliver materials in their original unopened containers with manufacturer's name and product identification.
- B. Store in a location providing protection from damage and exposure to the elements.

**1.5 WARRANTY**

- A. Firestopping work subject to the terms of the Article "Warranty of Construction", FAR clause 52.246-21, except extend the warranty period to five years.

**1.6 QUALITY ASSURANCE**

- A. FM, UL, or WH or other approved laboratory tested products will be acceptable.

**1.7 APPLICABLE PUBLICATIONS**

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
  - E84-10..... Surface Burning Characteristics of Building Materials
  - E814-11..... Fire Tests of Through-Penetration Fire Stops
- C. Factory Mutual Engineering and Research Corporation (FM):
  - Annual Issue Approval Guide Building Materials
- D. Underwriters Laboratories, Inc. (UL):
  - Annual Issue Building Materials Directory
  - Annual Issue Fire Resistance Directory



1479-10 ..... Fire Tests of Through-Penetration Firestops

- E. Warnock Hersey (WH):  
Annual Issue Certification Listings

## **PART 2 - PRODUCTS**

### **2.1 FIRESTOP SYSTEMS**

- A. Use either factory built (Firestop Devices) or field erected (through-Penetration Firestop Systems) to form a specific building system maintaining required integrity of the fire barrier and stop the passage of gases or smoke.
- B. Through-penetration firestop systems and firestop devices tested in accordance with ASTM E814 or UL 1479 using the "F" or "T" rating to maintain the same rating and integrity as the fire barrier being sealed. "T" ratings are not required for penetrations smaller than or equal to 100 mm (4 in) nominal pipe or 0.01 m<sup>2</sup> (16 sq. in.) in overall cross sectional area.
- C. Products requiring heat activation to seal an opening by its intumescence shall exhibit a demonstrated ability to function as designed to maintain the fire barrier.
- D. Firestop sealants used for firestopping or smoke sealing shall have following properties:
  - 1. Contain no flammable or toxic solvents.
  - 2. Have no dangerous or flammable out gassing during the drying or curing of products.
  - 3. Water-resistant after drying or curing and unaffected by high humidity, condensation or transient water exposure.
  - 4. When used in exposed areas, shall be capable of being sanded and finished with similar surface treatments as used on the surrounding wall or floor surface.
- E. Firestopping system or devices used for penetrations by glass pipe, plastic pipe or conduits, unenclosed cables, or other non-metallic materials shall have following properties:
  - 1. Classified for use with the particular type of penetrating material used.
  - 2. Sleeved penetrations containing loose electrical cables, computer data cables, and communications cables protected using firestopping systems that allow unrestricted cable changes without damage to the seal.
  - 3. Intumescent products which would expand to seal the opening and act as fire, smoke, toxic fumes, and, water sealant.
- F. Maximum flame spread of 25 and smoke development of 50 when tested in accordance with ASTM E84.
- G. FM, UL, or WH rated or tested by an approved laboratory in accordance with ASTM E814.
- H. Materials to be asbestos free.

### **2.2 SMOKE STOPPING IN SMOKE PARTITIONS**

- A. Use silicone sealant in smoke partitions as specified in Section 07 92 00, JOINT SEALANTS.
- B. Use mineral fiber filler and bond breaker behind sealant.

- C. Sealants shall have a maximum flame spread of 25 and smoke developed of 50 when tested in accordance with E84.
- D. When used in exposed areas capable of being sanded and finished with similar surface treatments as used on the surrounding wall or floor surface

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Submit product data and installation instructions, as required by article, submittals, after an on site examination of areas to receive firestopping.

#### **3.2 PREPARATION**

- A. Remove dirt, grease, oil, loose materials, or other substances that prevent adherence and bonding or application of the firestopping or smoke stopping materials.
- B. Remove insulation on insulated pipe for a distance of 150 mm (six inches) on either side of the fire rated assembly prior to applying the firestopping materials unless the firestopping materials are tested and approved for use on insulated pipes.
  - 1. The Contractor shall be responsible to replace insulation removed on either side of the fire rated assembly following completion of the installation.
  - 2. The Contractor shall be responsible to assure that the entire length of the insulated pipe, including the portion within the penetration, retains at least the same amount of thermal insulation as before.

#### **3.3 INSTALLATION**

- A. Do not begin work until the specified material data and installation instructions of the proposed firestopping systems have been submitted and approved.
- B. Install firestopping systems with smoke stopping in accordance with FM, UL, WH, or other approved system details and installation instructions.
- C. Install smoke stopping seals in smoke partitions.
- D. For firestopping systems involving the use of caulk, putty or any other pliable product, the finished installation shall be tooled to a smooth surface.

#### **3.4 LABELLING**

- A. Label through-penetration firestopping systems with self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestopping system installation where labels will be visible to anyone seeking to remove penetrating items or firestopping systems. Include the following information on labels:
  - 1. The words: "Warning -Through Penetration Firestopping System-Do Not Disturb. Notify Building Management of Any Damage."
  - 2. Through-Penetration firestopping system manufacturer's name.
  - 3. Through-Penetration firestopping system designation of FM, UL, WH or other approved system number or EJ used.

4. Installing Contractor's Name, Address and Phone Number.
5. Date of Installation.

### **3.5 CLEAN-UP AND ACCEPTANCE OF WORK**

- A. Clean all surfaces adjacent to sealed holes and joints to be free of excess firestopping materials and soiling as work progresses.
- B. As work on each floor is completed, remove materials, litter, and debris.
- C. Do not move materials and equipment to the next-scheduled work area until completed work is inspected and accepted by the COR.
- D. Clean up spills of liquid type materials.

--- E N D ---

**SECTION 07 92 00  
JOINT SEALANTS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

Section covers all sealant and caulking materials and their application, wherever required for complete installation of building materials or systems.

**1.2 RELATED WORK:**

- A. Sealing of site work concrete paving: Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.
- B. Masonry control and expansion joint: Section 04 20 00, UNIT MASONRY.
- C. Firestopping penetrations: Section 07 84 00, FIRESTOPPING SYSTEMS

**1.3 QUALITY CONTROL:**

- A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- C. Product Testing: Obtain test results from a qualified testing agency based on testing current sealant formulations within a 12-month period.
  - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021.
  - 2. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C920, and where applicable, to other standard test methods.
  - 3. Test elastomeric joint sealants according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C920 for adhesion and cohesion under cyclic movement, adhesion-in peel, and indentation hardness.
  - 4. Test other joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.
- D. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to joint substrates in accordance with sealant manufacturer's recommendations:
  - 1. Locate test joints where indicated or, if not indicated, as directed by COR.
  - 2. Conduct field tests for each application indicated below:
    - a. Each type of elastomeric sealant and joint substrate indicated.
    - b. Each type of non-elastomeric sealant and joint substrate indicated.
  - 3. Notify COR seven days in advance of dates and times when test joints will be erected.
  - 4. Arrange for tests to take place with joint sealant manufacturer's technical representative present.

- E. Mockups: Before installing joint sealants, apply elastomeric sealants as follows to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution:
  - 1. Joints in mockups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants, which are specified by reference to this section.

**1.4 SUBMITTALS:**

- A. Submit in accordance with Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- B. Manufacturer's installation instructions for each product used.
- C. Cured samples of exposed sealants for each color where required to match adjacent material.
- D. Manufacturer's Literature and Data:
  - 1. Caulking compound
  - 2. Primers
  - 3. Sealing compound, each type, including compatibility when different sealants are in contact with each other.

**1.5 PROJECT CONDITIONS:**

- A. Environmental Limitations:
  - 1. Do not proceed with installation of joint sealants under following conditions:
    - a. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below (40 °F).
    - b. When joint substrates are wet.
- B. Joint-Width Conditions:
  - 1. Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
- C. Joint-Substrate Conditions:
  - 1. Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

**1.6 DELIVERY, HANDLING, AND STORAGE:**

- A. Deliver materials in manufacturers' original unopened containers, with brand names, date of manufacture, shelf life, and material designation clearly marked thereon.
- B. Carefully handle and store to prevent inclusion of foreign materials.
- C. Do not subject to sustained temperatures exceeding (90° F) or less than (40° F).

**1.7 DEFINITIONS:**

- A. Definitions of terms in accordance with ASTM C717 and as specified.
- B. Back-up Rod: A type of sealant backing.
- C. Bond Breakers: A type of sealant backing.
- D. Filler: A sealant backing used behind a back-up rod.

**1.8 WARRANTY:**

- A. Warranty exterior sealing against leaks, adhesion, and cohesive failure, and subject to terms of "Warranty of Construction" Article specified in Section 01 00 00, GENERAL REQUIREMENTS, except that warranty period shall be extended to two years.
- B. General Warranty: Special warranty specified in this Article shall not deprive Government of other rights Government may have under other provisions of Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of Contract Documents.

**1.9 APPLICABLE PUBLICATIONS:**

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Society for Testing and Materials (ASTM):
  - C509-06 .....Elastomeric Cellular Preformed Gasket and Sealing Material.
  - C612-10 .....Mineral Fiber Block and Board Thermal Insulation.
  - C717-10 .....Standard Terminology of Building Seals and Sealants.
  - C834-10 .....Latex Sealants.
  - C919-08. ....Use of Sealants in Acoustical Applications.
  - C920-10 .....Elastomeric Joint Sealants.
  - C1021-08 .....Laboratories Engaged in Testing of Building Sealants.
  - C1193-09 .....Standard Guide for Use of Joint Sealants.
  - C1330-02 (R2007) .....Specifications for Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.
  - D1056-07 .....Specification for Flexible Cellular Materials—Sponge or Expanded Rubber.
  - E84-09.....Surface Burning Characteristics of Building Materials.
- C. Sealant, Waterproofing and Restoration Institute (SWRI).
  - The Professionals' Guide

**PART 2 - PRODUCTS**

**2.1 SEALANTS:**

- A. S-1:
  - 1. ASTM C920, polyurethane or polysulfide.
  - 2. Type M.
  - 3. Class 25.
  - 4. Grade NS.
  - 5. Shore A hardness of 20-40
- B. S-2:
  - 1. ASTM C920, polyurethane or polysulfide.

2. Type M.
  3. Class 25.
  4. Grade P.
  5. Shore A hardness of 25-40.
- C. S-3:
1. ASTM C920, polyurethane or polysulfide.
  2. Type S.
  3. Class 25, joint movement range of plus or minus 50 percent.
  4. Grade NS.
  5. Shore A hardness of 15-25.
  6. Minimum elongation of 700 percent.
- D. S-4:
1. ASTM C920 polyurethane or polysulfide.
  2. Type S.
  3. Class 25.
  4. Grade NS.
  5. Shore A hardness of 25-40.
- E. S-6:
1. ASTM C920, silicone, neutral cure.
  2. Type S.
  3. Class: Joint movement range of plus 100 percent to minus 50 percent.
  4. Grade NS.
  5. Shore A hardness of 15-20.
  6. Minimum elongation of 1200 percent.
- F. S-7:
1. ASTM C920, silicone, neutral cure.
  2. Type S.
  3. Class 25.
  4. Grade NS.
  5. Shore A hardness of 25-30.
  6. Structural glazing application.
- G. S-8:
1. ASTM C920, silicone, acetoxycure.
  2. Type S.
  3. Class 25.
  4. Grade NS.
  5. Shore A hardness of 25-30.

6. Structural glazing application.

H. S-9:

1. ASTM C920 silicone.
2. Type S.
3. Class 25.
4. Grade NS.
5. Shore A hardness of 25-30.
6. Non-yellowing, mildew resistant.

**2.2 CAULKING COMPOUND:**

- A. C-1: ASTM C834, acrylic latex.
- B. C-2: One component acoustical caulking, non drying, non hardening, synthetic rubber.

**2.3 COLOR:**

- A. Sealants used with exposed masonry shall match color of brick.
- B. Sealants used with unpainted concrete shall match color of adjacent concrete.
- C. Color of sealants for other locations shall be light gray or aluminum, unless specified otherwise.
- D. Caulking shall be light gray or white, unless specified otherwise.

**2.4 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. Cylindrical Sealant Backings: ASTM C1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
  1. Type C: Closed-cell material with a surface skin.
- C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 32° C (minus 26° F). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.
- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

**2.5 FILLER:**

- A. Mineral fiber board: ASTM C612, Class 1.
- B. Thickness same as joint width.
- C. Depth to fill void completely behind back-up rod.



**2.6 PRIMER:**

- A. As recommended by manufacturer of caulking or sealant material.
- B. Stain free type.

**2.7 CLEANERS-NON POUROUS SURFACES:**

- A. Chemical cleaners acceptable to manufacturer of sealants and sealant backing material, free of oily residues and other substances capable of staining or harming joint substrates and adjacent non-porous surfaces and formulated to promote adhesion of sealant and substrates.

**PART 3 - EXECUTION**

**3.1 INSPECTION:**

- A. Inspect substrate surface for bond breaker contamination and unsound materials at adherent faces of sealant.
- B. Coordinate for repair and resolution of unsound substrate materials.
- C. Inspect for uniform joint widths and that dimensions are within tolerance established by sealant manufacturer.

**3.2 PREPARATIONS:**

- A. Prepare joints in accordance with manufacturer's instructions and SWRI.
- B. Clean surfaces of joint to receive caulking or sealants leaving joint dry to the touch, free from frost, moisture, grease, oil, wax, lacquer paint, or other foreign matter that would tend to destroy or impair adhesion.
  - 1. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants.
  - 2. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Porous joint surfaces include the following:
    - a. Concrete.
    - b. Masonry.
    - c. Unglazed surfaces of ceramic tile.
  - 3. Remove laitance and form-release agents from concrete.
  - 4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
    - a. Metal.
    - b. Glass.
    - c. Porcelain enamel.
    - d. Glazed surfaces of ceramic tile.
- C. Do not cut or damage joint edges.
- D. Apply masking tape to face of surfaces adjacent to joints before applying primers, caulking, or sealing compounds.

1. Do not leave gaps between ends of sealant backings.
  2. Do not stretch, twist, puncture, or tear sealant backings.
  3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- E. Apply primer to sides of joints wherever required by compound manufacturer's printed instructions.
1. Apply primer prior to installation of back-up rod or bond breaker tape.
  2. Use brush or other approved means that will reach all parts of joints.
- F. Take all necessary steps to prevent three sided adhesion of sealants.

### **3.3 BACKING INSTALLATION:**

- A. Install back-up material, to form joints enclosed on three sides as required for specified depth of sealant.
- B. Where deep joints occur, install filler to fill space behind the back-up rod and position the rod at proper depth.
- C. Cut fillers installed by others to proper depth for installation of back-up rod and sealants.
- D. Install back-up rod, without puncturing the material, to a uniform depth, within plus or minus 3 mm (1/8 inch) for sealant depths specified.
- E. Where space for back-up rod does not exist, install bond breaker tape strip at bottom (or back) of joint so sealant bonds only to two opposing surfaces.
- F. Take all necessary steps to prevent three sided adhesion of sealants.

### **3.4 SEALANT DEPTHS AND GEOMETRY:**

- A. At widths up to 6 mm (1/4 inch), sealant depth equal to width.
- B. At widths over 6 mm (1/4 inch), sealant depth 1/2 of width up to 13 mm (1/2 inch) maximum depth at center of joint with sealant thickness at center of joint approximately 1/2 of depth at adhesion surface.

### **3.5 INSTALLATION:**

- A. General:
1. Apply sealants and caulking only when ambient temperature is between 5° C and 38° C (40° and 100° F).
  2. Do not use polysulfide base sealants where sealant may be exposed to fumes from bituminous materials, or where water vapor in continuous contact with cementitious materials may be present.
  3. Do not use sealant type listed by manufacture as not suitable for use in locations specified.
  4. Apply caulking and sealing compound in accordance with manufacturer's printed instructions.
  5. Avoid dropping or smearing compound on adjacent surfaces.
  6. Fill joints solidly with compound and finish compound smooth.
  7. Tool joints to concave surface unless shown or specified otherwise.

8. Apply compounds with nozzle size to fit joint width.
9. Test sealants for compatibility with each other and substrate. Use only compatible sealant.
- B. For application of sealants, follow requirements of ASTM C1193 unless specified otherwise.
- C. Where gypsum board partitions are of sound rated, fire rated, or smoke barrier construction, follow requirements of ASTM C919 only to seal all cut-outs and intersections with the adjoining construction unless specified otherwise.
  1. Apply a 6 mm (1/4 inch) minimum bead of sealant each side of runners (tracks), including those used at partition intersections with dissimilar wall construction.
  2. Coordinate with application of gypsum board to install sealant immediately prior to application of gypsum board.
  3. Partition intersections: Seal edges of face layer of gypsum board abutting intersecting partitions, before taping and finishing or application of veneer plaster-joint reinforcing.
  4. Openings: Apply a 6 mm (1/4 inch) bead of sealant around all cut-outs to seal openings of electrical boxes, ducts, pipes and similar penetrations. To seal electrical boxes, seal sides and backs.
  5. Control Joints: Before control joints are installed, apply sealant in back of control joint to reduce flanking path for sound through control joint.

### **3.6 CLEANING:**

- A. Fresh compound accidentally smeared on adjoining surfaces: Scrape off immediately and rub clean with a solvent as recommended by the caulking or sealant manufacturer.
- B. After filling and finishing joints, remove masking tape.
- C. Leave adjacent surfaces in a clean and unstained condition.

### **3.7 LOCATIONS:**

- A. Exterior Building Joints, Horizontal and Vertical:
  1. Metal to Metal: Type S-1, S-2
  2. Metal to Masonry or Stone: Type S-1
  3. Masonry to Masonry or Stone: Type S-1
  4. Cast Stone to Cast Stone: Type S-1
  5. Threshold Setting Bed: Type S-1, S-3, S-4
  6. Masonry Expansion and Control Joints: Type S-6
  7. Wood to Masonry: Type S-1
- B. Metal Reglets and Flashings:
  1. Flashings to Wall: Type S-6
  2. Metal to Metal: Type S-6
- C. Sanitary Joints:
  1. Walls to Plumbing Fixtures: Type S-9
  2. Counter Tops to Walls: Type S-9

3. Pipe Penetrations: Type S-9
- D. High Temperature Joints over 204 degrees C (400 degrees F):
  1. Exhaust Pipes, Flues, Breech Stacks: Type S-7 or S-8
- E. Interior Caulking:
  1. Typical Narrow Joint 6 mm, (1/4 inch) or less at Walls and Adjacent Components: Type C-1.
  2. Perimeter of Doors, Windows, Access Panels which Adjoin Concrete or Masonry Surfaces: Type C-1.
  3. Joints at Masonry Walls and Columns, Piers, Concrete Walls or Exterior Walls: Types C-1 and C-2.
  4. Exposed Isolation Joints at Top of Full Height Walls: Types C-1 and C-2.
  5. Exposed Acoustical Joint at Sound Rated Partitions Type C-2.
  6. Concealed Acoustic Sealant Types S-4, C-1 and C-2.

--- E N D ---

**SECTION 07 95 13**  
**EXPANSION JOINT COVER ASSEMBLIES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Section specifies floor, wall and ceiling building expansion joint assemblies.
- B. Types of assemblies:
  - Metal Plate Cover
  - Elastomeric Joint Covers

**1.2 RELATED WORK**

- A. Sheet Metal Expansion Joint Seals: Section 07 60 00, FLASHING AND SHEET METAL.
- B. Roof Expansion Joint Cover Assemblies: Section 07 71 00, ROOF SPECIALTIES.

**1.3 QUALITY ASSURANCE**

- A. Project Conditions:
  - 1. Check actual locations of walls and other construction, to which work must fit, by accurate field measurements before fabrication.
  - 2. Show recorded measurements on final shop drawings.
- B. Fire tests performed by Factory Mutual, Underwriters Laboratories, Inc., Warnock Hersey or other approved independent testing laboratory.

**1.4 DELIVERY STORAGE AND HANDLING**

- A. Take care in handling of materials so as not to injure finished surface and components.
- B. Store materials under cover in a dry and clean location off the ground.
- C. Remove materials which are damaged or otherwise not suitable for installation from job site and replace with acceptable materials.

**1.5 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SAMPLES AND SHOP DRAWINGS.
- B. Manufacturer's Literature and Data:
  - 1. Submit copies of manufacturer's current literature and data for each item specified.
  - 2. Clearly indicate movement capability of cover assemblies and suitability of material used in exterior seals for ultraviolet exposure.
- C. Certificates: Material test reports from approved independent testing laboratory indicating and interpreting test results relative to compliance of fire-rated expansion joint assemblies with requirements specified.
- D. Shop Drawings:
  - 1. Showing full extent of expansion joint cover assemblies; include large-scale details indicating profiles of each type of expansion joint cover assembly, splice joints between sections,

- joiners with other type assemblies, special end conditions, anchorages, fasteners, and relationship to adjoining work and finishes.
2. Include description of materials and finishes and installation instructions.
- E. Samples:
1. Samples of each type and color of metal finish on metal of same thickness and alloy used in work.

## 1.6 APPLICABLE PUBLICATIONS

- A. Publications listed form part of this specification to extent referenced. Publications are referred to in text by basic designation only.
- B. American Society for Testing and Materials (ASTM):
- A36/A36M-08 ..... Structural Steel
- A167-99 (R2009)..... Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
- A283/A283M-07 ..... Low and Intermediate Tensile Strength Carbon Steel Plates
- A786/A786M-05(R2009) ..... Rolled Steel Floor Plates
- B36/B36M-08 ..... Brass, Plate, Sheet, Strip, and Rolled Bar
- B121-01(R2006)..... Lead Brass Plate, Sheet, Strip and Rolled Bar
- B209M-07..... Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
- B221M-08..... Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes (Metric)
- B455-10..... Copper-Zinc Lead Alloy (Leaded Brass) Extruded Shapes
- C864-05 ..... Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers
- C920-11 ..... Elastomeric Joint Sealants
- D1187-97 (R2002) ..... Asphalt Base Emulsions for Use as Protective Coatings for Metal
- D2287-96 (R2010) ..... Non-rigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
- E119-10..... Fire Tests of Building Construction and Materials
- E814-11..... Fire Tests of Through-Penetration Fire Stops
- C. The National Association of Architectural Metal Manufacturers (NAAMM):
- AMP 500 Series ..... Metal Finishes Manual.
- D. National Fire Protection Association (NFPA):
- 251-06 ..... Tests of Fire Endurance of Building Construction and Materials
- E. Underwriters Laboratories Inc. (UL):
- 263-11 ..... Fire Tests of Building Construction and Materials

## PART 2 - PRODUCTS

## 2.1 MATERIALS

- A. Stainless Steel: ASTM A167, Type 302 or 304.
- B. Structural Steel Shapes: ASTM A36.
- C. Steel Plate: ASTM A283, Grade C.
- D. Rolled Steel Floor Plate: ASTM A786.
- E. Aluminum:
  - 1. Extruded: ASTM B221, alloy 6063-T5.
  - 2. Plate and Sheet: ASTM B209, alloy 6061-T6.
- F. Thermoplastic Rubber:
  - 1. ASTM C864.
  - 2. Dense Neoprene or other material standard with expansion joint manufacturers having the same physical properties.
- G. Vinyl Invertor Sealant Waterstops: Manufacturers' standard shapes and grade.
- H. Fire Barrier:
  - 1. Designed for indicated or required dynamic structural movement without material degradation or fatigue.
  - 2. Tested in maximum joint width condition as a component of an expansion joint cover assembly in accordance with UL 263 NFPA 251, or ASTM E119 and E814, including hose steam test at full-rated period.
- I. Zinc-Molybdate Primer: Fed. Spec. TT-P-645.
- J. Accessories:
  - 1. Manufacturer's standard anchors, fasteners, set screws, spaces, flexible secondary water stops or seals and filler materials, drain tubes, adhesive and other accessories as indicated or required for complete installations.
  - 2. Compatible with materials in contact.
  - 3. Water stops.

## 2.2 FABRICATION

- A. General:
  - 1. Use ceiling and wall expansion joint cover assemblies of same design as floor to wall and floor to floor expansion joint cover assemblies. Unless shown otherwise.
  - 2. Provide expansion joint cover assemblies of design, basic profile, materials and operation indicated required to accommodate joint size variations in adjacent surfaces, and as required for anticipated structural movement.
  - 3. Deliver to job site ready for use and fabricated in as large sections and assemblies as practical. Assemblies identical to submitted and reviewed shop drawings, samples and certificates.

4. Furnish units in longest practicable lengths to minimize number of end joints. Provide mitered corners where joint changes directions or abuts other materials.
  5. Include closure materials and transition pieces, tee-joints, corners, curbs, cross-connections and other assemblies.
  6. Fire Performance Characteristics:
    - a. Provide expansion joint cover assemblies identical to those of assemblies whose fire resistance has been determined per ASTM E119 and E814, NFPA 251, or UL 263 including hose stream test at full-rated period.
    - b. Fire rating: Not less than rating of adjacent floor or wall construction.
  7. Compression Seals: Prefabricate from thermoplastic rubber or dense neoprene to sizes and approximate profiles shown.
- B. Floor-to-Floor Metal Plate Joints:
1. Frames on each side of joint designed to support cover plate of design shown and compatible with existing to new floor construction.
    - a. Continuous frame designed to finish flush with adjacent floor of profile indicated with seating surface and raised floor rim to accommodate flooring.
    - b. Provide concealed bolt and steel anchors for embedment in concrete.
    - c. Frame and cover plates of some metal where exposed.
      - 1) Design cover plates to support 180 Kg (400 lbs) per 0.3 square meters (1-square foot).
      - 2) Cover plates free of rattle due to traffic.
      - 3) No gaps or buldges occur on filler material during design movement of joint.
      - 4) Provide manufacturer's continuous standard flexible vinyl water stop under floor joint cover assemblies.
- C. Floor-to-Wall Metal Plate Joints:
1. Provide one frame on floor side of joint only. Provide wall side frame where required by manufacturer's design.
  2. Angle Cover Plates: Provide angle cover plates for joints to wall with countersunk flat-head exposed fasteners for securing to wall unless shown otherwise.
  3. Space fasteners as recommended by manufacturer.
  4. Match cover of adjacent floor to floor cover.
- D. Interior Wall Joint Cover Assemblies:
1. Surface Mounted Metal Cover Plates:
    - a. Concealed frame for fastening to wall on one sides of joint.
    - b. Extend cover to lap each side of joint and to permit free movement on one side.
    - c. Provide concealed attachment of cover to frame cover in close contact with adjacent finish wall surfaces.



- d. Use angle cover plates at intersection of walls.
  - e. Use smooth surface cover plates matching floor plates.
  - f. Use expansion fire inserts in fire rated walls, rated same as hour rating of wall.
- E. Exterior Wall Joint Assemblies:
- 1. Variable movement with seal designed to prevent water and air infiltration.
  - 2. Use vinyl seal strip as secondary seal behind primary seal.
  - 3. Cover Plate Assemblies:
    - a. Surface mounted cover plate.
    - b. Concealed frame for fastening to wall on one side of joint.
    - c. Extend cover to lap each side of joint and to permit free movement on one side.
    - d. Provide concealed attachment of cover to frame for cover with cover in close contact with adjacent finish surfaces.
    - e. Use angle cover plate of intersection of walls.
  - 4. Extruded thermoplastic rubber joint assemblies.
    - a. Aluminum frames both sides of joint.
      - 1) Designed to receive flexible rubber primary seal on exposed face after installation of frame.
      - 2) Designed to receive continuous secondary vinyl sheet seal.
      - 3) Anchor spaced at ends and not over 600 mm (24-inches).
    - b. Provide factory heat welded transitions where directional changes occur to ensure a watertight system.
- F. Ceiling and Soffit Assemblies:
- 1. Variable movement vinyl insert in metal frame on both sides of joint.
  - 2. Designed for flush mounting with no exposed fasteners.
  - 3. Vinyl insert locked into metal frame.
  - 4. Vinyl insert semi rigid either flush face or accordion shape as showed to span joint width without sagging.

## **2.3 METAL FINISHES**

- A. General:
- 1. Apply finishes in factory after products are fabricated.
  - 2. Protect finishes on exposed surfaces with protective covering before shipment.
- B. Aluminum Finishes:
- 1. Finish letters and numbers for anodized aluminum are in accordance with the NAAMM AMP 501, Aluminum Association's Designation System).
    - a. Clear anodized finish: AA-C22A41 Chemically etched medium matte, clear anodic coating, Class I Architectural, 0.7 - mil thick.

2. Factory-Primed Concealed Surface: NAAMM AMP 505 Protect concealed aluminum surfaces that will be in contact with plaster, concrete or masonry surfaces when installed by applying a shop coat of zinc-molybdate primer to contact surfaces. Provide minimum dry film thickness of 2.0 mils.
  - a. Stainless Steel: NAAMM AMP 503, finish No. 2B.
  - b. Carbon Steel: NAAMM AMP 504, Galvanized 690.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Manufacturer's representative shall make a thorough examination of surfaces receiving work of this section.
- B. Before starting installation, notify prime contractor of defects which would affect satisfactory completion of work.

#### **3.2 PREPARATION**

- A. Verify measurements and dimensions at job site and cooperate in coordination and scheduling of work with work of related trades.
- B. Give particular attention to installation of items embedded in concrete and masonry so as not to delay job progress.
- C. Provide templates to related trade for location of support and anchorage items.

#### **3.3 INSTALLATION**

- A. Install in accordance with manufacturers installation instructions unless specified otherwise.
- B. Provide anchorage devices and fasteners for securing expansion joint assemblies to in-place construction including threaded fasteners with drilled-in fasteners for masonry and concrete where anchoring members are not embedded in concrete. Provide metal fasteners of type and size to suit type of construction indicated and provide for secure attachment of expansion joint cover assemblies.
- C. Perform cutting, drilling and fitting required for installation of expansion joint cover assemblies.
- D. Install joint cover assemblies in true alignment and proper relationship to expansion joint opening and adjoining finished surfaces measured from established lines and levels.
- E. Allow for thermal expansion and contraction of metal to avoid buckling.
- F. Set floor covers at elevations flush with adjacent finished floor materials unless shown otherwise.
- G. Material and method of grouting floor frames set in prepared recesses in accordance with manufacturer's instructions.
- H. Locate wall, ceiling and soffit covers in continuous contact with adjacent surfaces. Securely attach in place with required accessories.
- I. Locate anchors at interval recommended by manufacturer, but not less than 75 mm (3-inches) from each ends, and, not more than 600 mm (24-inches) on centers.

- J. Maintain continuity of expansion joint cover assemblies with end joints held to a minimum and metal members aligned mechanically using splice joints.
- K. Cut and fit ends to produce joints that will accommodate thermal expansion and contraction of metal to avoid buckling of frames or plates.
- L. Flush Metal Cover Plates:
  - 1. Secure flexible filler between frames so that it will compress and expand.
  - 2. Adhere flexible filler materials to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.
- M. Waterstops:
  - 1. Install in conjunction with floor joints and where shown, run continuously to prevent water damage to finish spaces.
  - 2. Provide seal with frame to prevent water leakage.
  - 3. Provide outlet tubes from waterstops to drain to prevent damage to finish spaces.
- N. Fire Barriers:
  - 1. Install in compliance with tested assembly.
  - 2. Install in floors and in fire rated walls.
  - 3. Use fire barrier sealant or caulk supplied with system.
- O. Sealants:

Install to prevent water and air infiltration.
- P. Vertical Exterior Extruded Thermoplastic Rubber.
  - 1. Install side frames mounted on sealant or butyl caulk tape with appropriate anchors 600 mm (24 inches) on center complete with independent continuous PVC back seal.
  - 2. Install primary seals retained in extruded aluminum side frames.
- Q. Installation of Extruded Thermoplastic Rubber or Seals:
  - 1. For straight sections, provide preformed seals in continuous lengths.
  - 2. Vulcanize or heat-seal field splice joints to provide watertight joints using manufacturer's recommended procedures.

### **3.4 PROTECTION**

- A. Take proper precautions to protect the expansion joint covers from damage after they are in place.
- B. Cover floor joints with plywood where wheel traffic occurs.

--- E N D ---

**SECTION 08 11 13**  
**HOLLOW METAL DOORS AND FRAMES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Hollow metal doors hung in hollow metal frames at exterior locations.
  - 2. Hollow metal door frames for wood doors at interior locations.

**1.2 RELATED REQUIREMENTS**

- A. Frames fabricated of structural steel: Section 05 50 00, METAL FABRICATIONS.
- B. Door Hardware: Section 08 71 00, DOOR HARDWARE.
- C. Glazing: Section 08 80 00, GLAZING.

**1.3 APPLICABLE PUBLICATIONS**

- A. Comply with references to extent specified in this section.
- B. American National Standard Institute (ANSI):
  - 1. A250.8-2014 - Standard Steel Doors and Frames.
- C. ASTM International (ASTM):
  - 1. A240/A240M-15b - Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
  - 2. A653/A653M-15 - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip.
  - 3. A1008/A1008M-15 - Steel, Sheet, Cold-Rolled, Carbon, Structural, High Strength Low Alloy and High Strength Low Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
  - 4. B209-14 - Aluminum and Aluminum-Alloy Sheet and Plate.
  - 5. B209M-14 - Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
  - 6. B221-14 - Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
  - 7. B221M-13 - Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).
  - 8. D3656/D3656M-13 - Insect Screening and Louver Cloth Woven from Vinyl Coated Glass Yarns.
  - 9. E90-09 - Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- D. Federal Specifications (Fed. Spec.):
  - 1. L-S-125B - Screening, Insect, Nonmetallic.
- E. Master Painters Institute (MPI):
  - 1. No. 18 - Primer, Zinc Rich, Organic.

- F. National Association of Architectural Metal Manufacturers (NAAMM):
  - 1. AMP 500-06 - Metal Finishes Manual.
- G. National Fire Protection Association (NFPA):
  - 1. 80-16 - Fire Doors and Other Opening Protectives.
- H. UL LLC (UL):
  - 1. 10C-09 - Positive Pressure Fire Tests of Door Assemblies.
  - 2. 1784-15 - Air Leakage Tests of Door Assemblies and Other Opening Protectives.

#### **1.4 SUBMITTALS**

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submittal Drawings:
  - 1. Show size, configuration, and fabrication and installation details.
- C. Manufacturer's Literature and Data:
  - 1. Description of each product.
  - 2. Include schedule showing each door and frame requirements fire label and smoke control label for openings.
  - 3. Installation instructions.
- D. Sustainable Construction Submittals:
  - 1. Recycled Content: Identify post-consumer and pre-consumer recycled content percentage by weight.
- E. Test reports: Certify each product complies products comply with specifications.
- F. Qualifications: Substantiate qualifications comply with specifications.
  - 1. Manufacturer with project experience list

#### **1.5 QUALITY ASSURANCE**

- A. Manufacturer Qualifications:
  - 1. Regularly manufactures specified products.
  - 2. Manufactured specified products with satisfactory service on five similar installations for minimum five years.
    - a. Project Experience List: Provide contact names and addresses for completed projects.

#### **1.6 DELIVERY**

- A. Fasten temporary steel spreaders across the bottom of each door frame before shipment.
- B. Deliver products in manufacturer's original sealed packaging.
- C. Mark packaging, legibly. Indicate manufacturer's name or brand, type, production run number, and manufacture date.
- D. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

#### **1.7 STORAGE AND HANDLING**

- A. Store products indoors in dry, weathertight conditioned facility.

- B. Protect products from damage during handling and construction operations.

## **1.8 WARRANTY**

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

## **PART 2 - PRODUCTS**

### **2.1 SYSTEM PERFORMANCE**

- A. Design hollow metal doors and frames complying with specified performance:
  - 1. Fire Doors and Frames: UL 10C; NFPA 80 labeled.
    - a. Fire Ratings: See drawings.
  - 2. Smoke Control Doors and Frames: UL 1784; NFPA 80 labeled, maximum 0.15424 cu. m/s/sq. m (3.0 cfm/sf) at 24.9 Pa (0.10 inches water gage) pressure differential.
  - 3. Thermal Resistance: R10 R-value, minimum at exterior doors.

### **2.2 MATERIALS**

- A. Sheet Steel: ASTM A1008/A1008M, cold-rolled.
- B. Galvanized Sheet Steel: ASTM A653.
- C. Insect Screening: ASTM D3656/D3656M, 18 by 18 aluminum wire mesh.
- D. Aluminum Sheet: ASTM B209M (ASTM B209).
- E. Aluminum Extrusions: ASTM B221M (ASTM B221).

### **2.3 PRODUCTS - GENERAL**

- A. Provide hollow metal doors and frames from one manufacturer.

### **2.4 HOLLOW METAL DOORS**

- A. Hollow Metal Doors: ANSI A250.8; 44 mm (1-3/4 inches) thick.
  - 1. Interior Doors: Level 3 and Physical Performance Level A, extra-heavy duty; Model 2, seamless at all locations.
  - 2. Exterior Doors: Level 3 and Physical Performance Level A, extra-heavy duty; Model 2, seamless at all locations.
- B. Door Faces:
  - 1. Interior Doors: Galvanized sheet steel minimum Z120 or ZF120 (G40 or A40).
  - 2. Exterior Doors: Galvanized sheet steel minimum Z275 (G90) coating .
- C. Door Cores:
  - 1. Interior Doors: vertical steel stiffeners.
  - 2. Exterior Doors: polyurethane .
  - 3. Fire Doors: Manufacturer's standard complying with specified fire rating performance.

### **2.5 HOLLOW METAL FRAMES**

- A. Hollow Metal Frames: ANSI A250.8; face welded . See drawings for sizes and designs.
  - 1. Interior Frames:

- a. Level 3 Hollow Metal Doors: 1.3 mm (0.053 inch) thick.
- b. Wood Doors and Borrowed Lights 1.3 mm (0.053 inch) thick.
- 2. Interior Borrowed Light Frames: 1.3 mm (0.051 inch) thick.
  - a. Interior Automatic Operator Door Frames: 1.7 mm (0.067 inch) thick.
  - b. Exterior Frames:
    - 1) Level 3 Hollow Metal Doors: 1.3 mm (0.053 inch) thick.
- B. Frame Materials:
  - 1. Interior Frames: Galvanized sheet steel minimum Z180 or ZF180 (G60 or A60) coating.
  - 2. Exterior Frames: Galvanized sheet steel minimum / Z275 (G90) coating.

## 2.6 FABRICATION

- A. Hardware Preparation: ANSI A250.8; for hardware specified in Section 08 71 00, DOOR HARDWARE.
- B. Hollow Metal Door Fabrication:
  - 1. Close top edge of exterior doors flush and seal to prevent water intrusion.
  - 2. Fill spaces between vertical steel stiffeners with insulation.
- C. Fire and Smoke Control Doors:
  - 1. Close top and vertical edges flush.
  - 2. Apply steel astragal to active leaf at pair and double egress doors.
    - a. Exception: Where vertical rod exit devices are specified for both leaves swinging in same direction.
  - 3. Fire and Smoke Control Door Clearances: NFPA 80.
- D. Custom Metal Hollow Doors:
  - 1. Provide custom hollow metal doors where nonstandard steel doors are shown on drawings.
    - a. Provide door sizes, design, materials, construction, gages, and finish as specified for standard steel doors.
- E. Hollow Metal Frame Fabrication:
  - 1. Fasten mortar guards to back of hardware reinforcements.
  - 2. Terminated Stops: ANSI A250.8.
  - 3. Frame Anchors:
    - a. Floor anchors:
      - 1) Provide extension type floor anchors to compensate for depth of floor fills.
      - 2) Provide 1.3 mm (0.053 inch) thick steel clip angles welded to jamb and drilled to receive floor fasteners.
      - 3) Provide 50 mm by 50 mm by 9 mm (2 inch by 2 inch by 3/8 inch) clip angle for lead lined frames, drilled for floor fasteners.
      - 4) Provide mullion 2.3 mm (0.093 inch) thick steel channel anchors, drilled for two floor fasteners and frame anchor screws.

- 5) Provide continuous 1 mm (0.042 inch) thick steel rough bucks drilled for floor fasteners and frame anchor screws for sill sections.
  - a) Space floor bolts 50 mm (2 inches) on center.
- b. Jamb anchors:
  - 1) Place anchors on jambs:
    - a) Near top and bottom of each frame.
    - b) At intermediate points at maximum 600 mm (24 inches) spacing.
  - 2) Form jamb anchors from steel minimum 1 mm (0.042 inch) thick.
  - 3) Anchors set in masonry: Provide adjustable anchors designed for friction fit against frame and extended into masonry minimum 250 mm (10 inches). Provide one of following types:
    - a) Wire Loop Type: 5 mm (3/16 inch) diameter wire.
    - b) T-Shape type.
    - c) Strap and stirrup type: Corrugated or perforated sheet steel.
  - 4) Anchors for stud partitions: Provide tabs for securing anchor to sides of studs. Provide one of the following:
    - a) Welded type.
    - b) Lock-in snap-in type.
  - 5) Anchors for frames set in prepared openings:
    - a) Steel pipe spacers 6 mm (1/4 inch) inside diameter, welded to plate reinforcing at jamb stops, or hat shaped formed strap spacers 50 mm (2 inches) wide, welded to jamb near stop.
    - b) Drill jamb stop and strap spacers for 6 mm (1/4 inch) flat head bolts to pass through frame and spacers.
    - c) Two piece frames: Subframe or rough buck drilled for 6 mm (1/4 inch) bolts.
  - 6) Anchors for observation windows and other continuous frames set in stud partitions.
    - a) Weld clip anchors to sills and heads of continuous frames over 1200 mm (4 feet) long.
    - b) Space maximum 600 mm (24 inches) on centers.
  - 7) Modify frame anchors to fit special frame and wall construction.
  - 8) Provide special anchors where shown on drawings and where required to suit application.

## 2.7 FINISHES

- A. Galvanized Steel : ANSI A250.8; shop primed.
- B. Finish exposed surfaces after fabrication.



## **2.8 ACCESSORIES**

- A. Primers: ANSI A250.8.
- B. Barrier Coating: ASTM D1187/D1187M.
- C. Welding Materials: AWS D1.1/D1.1M, type to suit application.
- D. Clips Connecting Members and Sleeves: Match door faces.
- E. Fasteners: Galvanized steel
  - 1. Metal Framing: Steel drill screws.
  - 2. Masonry and Concrete: Expansion bolts.
- F. Anchors: Galvanized steel.
- G. Galvanizing Repair Paint: MPI No. 18.
- H. Insulation: Unfaced mineral wool.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Examine and verify substrate suitability for product installation.
- B. Protect existing construction and completed work from damage.
- C. Apply barrier coating to metal surfaces in contact with cementitious materials to minimum 0.7 mm (30 mils) dry film thickness.

### **3.2 INSTALLATION - GENERAL**

- A. Install products according to manufacturer's instructions and approved submittal drawings .
  - 1. When manufacturer's instructions deviate from specifications, submit proposed resolution for Contracting Officer's Representative consideration.
  - 2. Install fire doors and frames according to NFPA 80.
  - 3. Install smoke control doors and frames according to NFPA 105.

### **3.3 FRAME INSTALLATION**

- A. Apply barrier coating to concealed surfaces of frames built into masonry.
- B. Plumb, align, and brace frames until permanent anchors are set.
  - 1. Use triangular bracing near each corner on both sides of frames with temporary wood spreaders at midpoint.
  - 2. Use wood spreaders at bottom of frame when shipping spreader is removed.
  - 3. Where construction permits concealment, leave shipping spreaders in place after installation, otherwise remove spreaders when frames are set and anchored.
  - 4. Remove wood spreaders and braces when walls are built and jamb anchors are secured.
- C. Floor Anchors:
  - 1. Anchor frame jambs to floor with two expansion bolts.
    - a. Lead Lined Frames: Use 9 mm (3/8 inch) diameter bolts.
    - b. Other Frames: Use 6 mm (1/4 inch) diameter bolts.

2. Power actuated drive pins are acceptable to secure frame anchors to concrete floors.
- D. Jamb Anchors:
  1. Masonry Walls:
    - a. Embed anchors in mortar.
    - b. Fill space between frame and masonry with grout or mortar as walls are built.
  2. Metal Framed Walls: Secure anchors to sides of studs with two fasteners through anchor tabs.
  3. Prepared Masonry and Concrete Openings:
    - a. Direct Securement: 6 mm (1/4 inch) diameter expansion bolts through spacers.
    - b. Subframe or Rough Buck Securement:
      - 1) 6 mm (1/4 inch) diameter expansion bolts on 600 mm (24 inch) centers.
      - 2) Power activated drive pins on 600 mm (24 inches) centers.
    - c. Secure two-piece frames to subframe or rough buck with machine screws on both faces.
- E. Touch up damaged factory finishes.
  1. Repair galvanized surfaces with galvanized repair paint.
  2. Repair painted surfaces with touch up primer.

### **3.4 DOOR INSTALLATION**

- A. Install doors plumb and level.
- B. Adjust doors for smooth operation.
- C. Touch up damaged factory finishes.
  1. Repair galvanized surfaces with galvanized repair paint.
  2. Repair painted surfaces with touch up primer.

### **3.5 CLEANING**

- A. Clean exposed door and frame surfaces. Remove contaminants and stains.

### **3.6 PROTECTION**

- A. Protect doors and frames from traffic and construction operations.
- B. Remove protective materials immediately before acceptance.
- C. Repair damage.

--- E N D ---

**SECTION 08 14 00**  
**INTERIOR WOOD DOORS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Interior flush wood doors transparent finish.
    - a. Fire rated doors.
    - b. Smoke rated doors.

**1.2 RELATED REQUIREMENTS**

- A. Door Hardware including hardware location (height): Section 08 71 00, DOOR HARDWARE.
- B. Installation of Doors and Hardware: Section 08 11 13, HOLLOW METAL DOORS AND FRAMES  
Section 08 71 00, DOOR HARDWARE.

**1.3 APPLICABLE PUBLICATIONS**

- A. Comply with references to extent specified in this section.
- B. American National Standards Institute/Window and Door Manufacturers Association (ANSI/WDMA):
  - 1. I.S. 1A-13 - Architectural Wood Flush Doors.
  - 2. I.S. 6A-13 - Interior Architectural Stile and Rails Doors.
- C. ASTM International (ASTM):
  - 1. E90-09 - Laboratory Measurements of Airborne Sound Transmission Loss of Building Partitions and Elements.
- D. National Fire Protection Association (NFPA):
  - 1. 80-16 - Fire Doors and Other Opening Protectives.
  - 2. 252-12 - Fire Tests of Door Assemblies.
- E. UL LLC (UL):
  - 1. 10C-09 - Positive Pressure Fire Tests of Door Assemblies.
- F. Window and Door Manufacturers Association (WDMA):
  - 1. TM 7-14 - Cycle-Slam Test.
  - 2. TM 8-14 - Hinge Loading Test.
  - 3. TM 10-14 - Screw Holding Capacity.

**1.4 SUBMITTALS**

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submittal Drawings:
  - 1. Show size, configuration, and fabrication and installation details.
  - 2. Include details of glazing.

3. Indicate project specific requirements not included in Manufacturer's Literature and Data submittal.
- C. Manufacturer's Literature and Data:
  1. Description of each product.
  2. Fire rated doors showing conformance with NFPA 80 .
- D. Samples:
  1. Corner section of flush veneered door 300 mm (12 inches) square, showing details of construction, labeled to show grade and type number and conformance to specified standard. Veneer sample 200 mm by 275 mm (8 inch by 11 inch) showing specified wood species sanded to receive a transparent finish. Factory finish veneer sample where the prefinished option is accepted.
- E. Test Reports: Indicate each product complies products comply with specifications.
  1. Screw Holding Capacity Test.
  2. Cycle-Slam Test.
  3. Hinge-Loading Test.
- F. Operation and Maintenance Data:
  1. Care instructions for each exposed finish product.

## **1.5 QUALITY ASSURANCE**

- A. Manufacturer Qualifications:
  1. Regularly and presently manufactures specified products.
  2. Manufactures specified products with satisfactory service on five similar installations for minimum five years.

## **1.6 DELIVERY**

- A. Deliver products in manufacturer's original sealed packaging.
  1. Minimum 0.15 mm (6 mil) polyethylene bags or cardboard packaging to remain unbroken during delivery and storage.
- B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, and manufacture date.
  1. Identify door opening corresponding to Door Schedule.
- C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

## **1.7 STORAGE AND HANDLING**

- A. Store products indoors in dry, weathertight conditioned facility.
  1. Store doors according to ANSI/WDMA I.S. 1A.
- B. Protect products from damage during handling and construction operations.

## **1.8 FIELD CONDITIONS**

- A. Environment:

1. Product Temperature: Minimum 21 degrees C (70 degrees F) for minimum 48 hours before installation.
2. Work Area Ambient Temperature Range: 21 to 27 degrees C (70 to 80 degrees F) continuously, beginning 48 hours before installation.
3. Install products when building is permanently enclosed and when wet construction is completed, dried, and cured.
  - a. Comply with door manufacturer's instructions for relative humidity.

## **1.9 WARRANTY**

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."
- B. Manufacturer's Warranty: Warrant interior factory finished flush wood doors against material and manufacturing defects.
  1. Warranty Period: Lifetime of original installation.

## **PART 2 - PRODUCTS**

### **2.1 PRODUCTS - GENERAL**

- A. Provide each product from one manufacturer.

### **2.2 FLUSH WOOD DOORS**

- A. General:
  1. ANSI/WDMA I.S. 1A, Extra Heavy Duty.
  2. Adhesive: Type II.
  3. Core: Structural composite lumber, except when mineral core is required for fire rating.
  4. Thickness: 44 mm (1-3/4 inches) unless otherwise shown or specified.
- B. Faces:
  1. ANSI/WDMA I.S. 1A.
  2. One species throughout project unless scheduled or otherwise shown.
  3. Transparent Finished Faces: Premium Grade. rotary cut, white birch .
    - a. AA Grade face veneer.
    - b. Match face veneers for doors for uniform effect of color and grain at joints.
    - c. Door Edges: Same species as door face veneer, except maple is acceptable for stile face veneer on birch doors.
    - d. In existing buildings, where doors are required to have transparent finish, use wood species, grade, and assembly of face veneers to match adjacent existing doors.
  4. Painted Finishes: Custom Grade, mill option close grained hardwood, premium or medium density overlay.
  5. Factory sand doors for finishing.

- C. Wood For Stops, Louvers, Muntins and Moldings For Flush Doors Required to Have Transparent Finish:
  - 1. Solid wood of same species as face veneer, except maple is acceptable on birch doors.
  - 2. Glazing:
    - a. On non-fire-rated doors, use applied wood stops nailed tightly on room side and attached on opposite side with flathead, countersunk wood screws, spaced approximately 125 mm (5 inches) on center.
- D. Fire-Rated Wood Doors:
  - 1. Fire Resistance Rating:
    - a. B Label: 1-1/2 hours.
    - b. C Label: 3/4 hour.
  - 2. Labels:
    - a. Comply with NFPA 252, UL 10C, and labeled by qualified testing and inspection agency showing fire resistance rating.
    - b. Metal labels with raised or incised markings.
  - 3. Performance Criteria for Stiles of Doors Utilizing Standard Mortise Leaf Hinges:
    - a. Hinge Loading: WDMA TM 8. Average of 10 test samples for Extra Heavy Duty doors.
    - b. Direct Screw Withdrawal: WDMA TM 10 for Extra Heavy Duty doors. Average of 10 test samples using a steel, fully threaded #12 wood screw.
    - c. Cycle-Slam: 1,000,000 cycles with no loose hinge screws or other visible signs of failure when tested according to WDMA TM 7.
  - 4. Hardware Reinforcement:
    - a. Provide fire rated doors with hardware reinforcement blocking.
    - b. Size of lock blocks as required to secure hardware specified.
    - c. Top, Bottom and Intermediate Rail Blocks: Minimum 125 mm (5 inches) by full core width.
    - d. Reinforcement blocking in compliance with labeling requirements.
    - e. Mineral material similar to core is not acceptable.
  - 5. Other Core Components: Manufacturer's standard as allowed by labeling requirements.
  - 6. Glazed Vision Panel Frame: Steel approved for use in labeled doors.
- E. Smoke Barrier Doors:
  - 1. Glazed Vision Panel Frame: Steel approved for use in labeled doors.

## **2.3 FABRICATION**

- A. Factory machine interior wood doors to receive hardware, bevels, undercuts, cutouts, accessories and fitting for frame.
  - 1. Factory fit fire rated doors according to NFPA 80.

- B. Rout doors for hardware using templates and location heights specified in Section 08 71 00, DOOR HARDWARE.
- C. Factory fit doors to frame, bevel lock edge of doors 3 mm (1/8 inch) for each 50 mm (2 inches) of door thickness undercut where shown .
- D. Clearances between Doors and Frames and Floors:
  - 1. Fire Rated Doors: Comply with NFPA 80.
    - a. Doors with Automatic Bottom Seal: Maximum clearance 10 mm (3/8 inch) at threshold.
    - b. Other Door Bottoms: Maximum 3 mm (1/8 inch) clearance at the jambs, heads, and meeting stiles, and a 19 mm (3/4 inch) clearance at bottom, except as otherwise specified.
  - 2. Door Jambs, Heads, and Meeting Stiles: Maximum 3 mm (1/8 inch).
- E. Provide cutouts for glazed openings.
- F. Finish surfaces, including both faces, top and bottom and edges of the doors smooth to touch.
- G. Identify each door on top edge.
  - 1. Mark with stamp, brand or other indelible mark, giving manufacturer's name, door's trade name, construction of door, date of manufacture and quality.
  - 2. Mark door or provide separate certification including name of inspection organization.
  - 3. Identify door manufacturing standard, including glue type.
  - 4. Identify veneer and quality certification.
  - 5. Identification of preservative treatment for stile and rail doors.

## **2.4 FINISHES**

- A. Factory Transparent Finish:
  - 1. Factory finish flush wood doors.
    - a. ANSI/WDMA I.S. 1A Section F-3 Finish System Descriptions for System 5, Conversion Varnish or System 7, Catalyzed Vinyl.
    - b. Use stain when required to produce finish specified in Section 09 06 00, SCHEDULE FOR FINISHES.

## **2.5 Tempered GLASS**

- A. Clear Tempered Glass:
  - 1. ASTM C1048, Kind FT, condition A, Type I, class 1, Quality q3.
  - 2. Thickness, 6mm (1/4 inch).

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Examine and verify substrate suitability for product installation.
  - 1. Verify door frames are properly anchored.

2. Verify door frames are plumb, square, in plane, and within tolerances for door installation.
- B. Protect existing construction and completed work from damage.
- C. Install astragal on active leaf of pair of smoke doors and one leaf of double egress smoke doors.

### **3.2 INSTALLATION**

- A. Install products according to manufacturer's instructions and approved submittal drawings .
  1. Install fire rated doors according to NFPA 80.
  2. When manufacturer's instructions deviate from specifications, submit proposed resolution for Contracting Officer's Representative consideration.

### **3.3 PROTECTION**

- A. After installation, place shipping container over door and tape in place.
  1. Do not apply tape to door faces and edges.
- B. Provide protective covering over exposed hardware in addition to covering door.
- C. Maintain covering in good condition until removal is directed by Contracting Officer's Representative.

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**SECTION 08 41 13**  
**ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Aluminum-framed entrances and storefronts.

**1.2 RELATED REQUIREMENTS**

- A. Glass and Glazing: Section 08 80 00, GLAZING.
- B. Hardware: Section 08 71 00, DOOR HARDWARE.

**1.3 APPLICABLE PUBLICATIONS**

- A. Comply with references to extent specified in this section.
- B. American Architectural Manufacturers Associations (AAMA):
  - 1. 2603-15 - Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
  - 2. 2604-13 - Performance Requirements and Test Procedures for High Performance Organic Coatings on Architectural Extrusions and Panels.
  - 3. 2605-13 - Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
- C. American Welding Society (AWS):
  - 1. D1.2/D1.2M-14 - Structural Welding Code - Aluminum.
- D. ASTM International (ASTM):
  - 1. A240/A240M-15b - Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
  - 2. B209-14 - Aluminum and Aluminum-Alloy Sheet and Plate.
  - 3. B209M-14 - Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
  - 4. B221-14 - Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
  - 5. B221M 13 - Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).
  - 6. D1187/D1187M-97(2011)e1 - Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
  - 7. E283-04(2012) - Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
  - 8. E330/E330M-14 -Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
  - 9. E331-00(2009) - Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

10. E1886-13a - Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missiles and Exposures to Cyclic Pressure Differentials.
11. E1996-14a - Performance of Exterior Windows, Curtain Walls, Doors, and impact Protective Systems Impacted by Windborne Debris in Hurricanes.
12. F468-15 - Nonferrous Bolts, Hex Cap Screws, and Studs for General Use.
13. F593-13a - Stainless Steel Bolts, Hex Cap Screws, and Studs.
- E. National Association of Architectural Metal Manufacturers (NAAMM):
  1. AMP 500-06 - Metal Finishes Manual.
- F. National Fenestration Rating Council (NFRC):
  1. 500-14(E1A0) - Determining Fenestration Product Condensation Resistance Values.
- G. United States Veterans Administration (VA):
  1. PSDSDD - Physical Security Design Standards Data Definitions.

#### **1.4 SUBMITTALS**

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submittal Drawings: Minimum 1 to 2 (half size) scale.
  1. Show size, configuration, and fabrication and installation details.
  2. Show anchorage and reinforcement.
  3. Show interface and relationship to adjacent work, including thermal, air, and water barrier continuity.
- C. Manufacturer's Literature and Data:
  1. Description of each product.
  2. Doors, each type.
  3. Entrance and Storefront construction.
  4. Installation instructions.
  5. Warranty.
- D. Samples:
  1. Door Corner Section: Minimum 450 mm x 450 mm (18 x 18 inches) for each specified door type, showing head rail and hinge stile, and insulation in flush panel door.
  2. Aluminum Anodized Finish: wo sample extrusions minimum 150 mm (6 inches) long for each specified color in sets of three showing maximum color range.
- E. Test reports: Certify each product complies with specifications.
- F. Certificates: Certify products comply with specifications.
  1. Certify anodized finish thickness.
- G. Qualifications: Substantiate qualifications comply with specifications.
  1. Manufacturer with project experience list.
  2. Installer with project experience list.
  3. Welders and welding procedures.

- H. Delegated Design Drawings and Calculations: Signed and sealed by responsible design professional.
  - 1. Show location and magnitude of loads applied to building structural frame.
  - 2. Identify deviations from details shown on drawings.
- I. Operation and Maintenance Data:
  - 1. Care instructions for each exposed finish product.

## **1.5 QUALITY ASSURANCE**

- A. Manufacturer Qualifications:
  - 1. Regularly manufactures specified products.
  - 2. Manufactured specified products with satisfactory service on five similar installations for minimum five years.
    - a. Project Experience List: Provide contact names and addresses for completed projects.
- B. Installer Qualifications: Manufacturer authorized representative.
  - 1. Regularly installs specified products.
  - 2. Installed specified products with satisfactory service on five similar installations for minimum five years.
    - a. Project Experience List: Provide contact names and addresses for completed projects.
- C. Welders and Welding Procedures Qualifications: AWS D1.2/D1.2M.

## **1.6 DELIVERY, STORAGE AND HANDLING**

- A. Deliver products in manufacturer's original sealed packaging.
- B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, production run number, and manufacture date.
- C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.
- D. Store products indoors in dry, weathertight conditioned facility.
- E. Protect products from damage during handling and construction operations.

## **1.7 WARRANTY**

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."
- B. Manufacturer's Warranty: Warrant painted finish against material and manufacturing defects.
  - 1. Warranty Period: 20 years.

## **PART 2 - PRODUCTS**

### **2.1 SYSTEM PERFORMANCE**

- A. Delegated Design: Prepare submittal documents including design calculations and drawings signed and sealed by registered design professional, licensed in state where work is located.

1. Minor deviations to details shown on drawings to accommodate manufacturer's standard products may be accepted by Contracting Officer's Representative when deviations do not affect design concept and specified performance.
- B. Design aluminum framed entrances and storefronts complying with specified performance:
  1. Wind Load Resistance: ASCE/SEI 7; Design criteria as indicated on Drawings when tested according to ASTM E330/E330M.
    - a. Wind Load: 1.4 kPa ( 30 psf) positive and negative, minimum.
    - b. Maximum Deflection: 1/175 of span, maximum with minimum 1.65 safety factor.
  2. Thermal Movement: Accommodate ambient temperature range of 67 degrees C (120 degrees F).
  3. Condensation Resistance: NFRC 500.
    - a. Fixed Framing: 45 CRF, minimum.
  4. Water Resistance: ASTM E331; No uncontrolled penetration at 380 Pa (8 psf), minimum, pressure differential.
  5. Fixed Framing Air Infiltration Resistance: ASTM E283; 0.30 L/s/sq. m (0.06 cfm/sf), maximum at 300 Pa (6.24 psf), minimum, pressure differential.
  6. Entrance Doors Air Infiltration Resistance: ASTM E283; maximum allowable at 75 Pa (1.57 psf), minimum, pressure differential.
    - a. Single Doors: 2.5 L/s/sq. m (0.5 cfm/sf).
    - b. Paired Doors: 6 L/s/sq. m (1.2 cfm/sf).
  7. Thermal Performance, Overall (Frame + Specified Glazing): When tested in accordance with AAMA 507, NFRC 100 and NFRC 200:
    - a. Thermal Transmittance U-Value: 0.36 BTU/HR/FT<sup>2</sup>/F or less.

## 2.2 MATERIALS

- A. Aluminum:
  1. Sheet Metal: ASTM B209M (ASTM B209), minimum 1.6 mm (0.063 inch) thick.
  2. Extrusions: ASTM B221M (ASTM B221).
    - a. Framing: Minimum 3 mm (0.125 inch) wall thickness.
    - b. Glazing Beads, Moldings, and Trim: Minimum 1.25 mm (0.050 inch) thick.
  3. Alloy 6063 temper T5 for doors, door frames, fixed glass sidelights storefronts.
  4. Alloy 6061 temper T6 for guide tracks for sliding doors and other extruded structural members.
  5. Color Anodized Aluminum: Provide aluminum alloy required to produce specified color.
- B. Stainless Steel: ASTM A240/A240M; Type 302 or Type 304.
- C. Thermal Break: Manufacturer standard low conductive material retarding heat flow in the framework, where insulating glass is scheduled.

## **2.3 PRODUCTS - GENERAL**

- A. Basis of Design: Section 09 06 00, SCHEDULE FOR FINISHES.
- B. Provide aluminum framed entrances and storefronts from one manufacturer and from one production run.
- C. Provide aluminum entrances, storefront, windows, systems from same manufacturer.
- D. Sustainable Construction Requirements:
  - 1. Aluminum Recycled Content: 80 percent total recycled content, minimum.

## **2.4 FRAMES**

- A. Framing Members: Extruded aluminum, thermally broken .
- B. Stops: Provide integral fixed stops and glass rebates and snap-on removable stops.
- C. Provide concealed screws, bolts and other fasteners.
- D. Secure cover boxes to frames in back of lock strike cutouts.

## **2.5 STILE AND RAIL DOORS**

- A. Stiles and Rails: Extruded aluminum, thermally broken.
  - 1. Thickness: 45 mm (1-3/4 inch).
  - 2. Stiles and Head Rails: 90 mm (3-1/2 inches) wide.
  - 3. Bottom Rails: 250 mm (10 inches) wide.
- B. Single-Acting Doors:
  - 1. Bevel: 3 mm (1/8 inch) at lock, hinge, and meeting stile edges.
  - 2. Clearances: 2 mm (1/16 inch) at hinge stiles, 3 mm (1/8 inch) at lock stiles and top rails, and 5 mm (3/16 inch) at floors and thresholds.
- C. Glass Rebates: Integral with stiles and rails.
- D. Glazing Beads: Extruded aluminum, 1.3 mm (0.050 inch) thick. Integral with stiles and rails or applied type, snap-fit secured.
- E. Stile and Rail Joints: Welded or interlocking dovetail joints between stiles and rails.
  - 1. Clamp door together through top and bottom rails with 9 mm (3/8 inch) primed steel tie rod extending into stiles, and having self-locking nut and washer at both ends.
  - 2. Reinforce stiles and rails to prevent door distortion when tie rods are tightened.
  - 3. Provide compensating spring-type washer under each nut for stress relief.
  - 4. Construct joints to remain rigid and tight when door is operated.
- F. Weather-stripping: Removable, woven pile type (silicone-treated) weather-stripping attached to aluminum or vinyl holder.
  - 1. Make slots for applying weather-stripping integral with doors and door frame stops.
  - 2. Apply continuous weather-stripping to heads, jambs, bottom, and meeting stiles of doors and frames so doors swing freely and close positively.

## **2.6 COLUMN COVERS AND TRIM**

- A. Column Covers and Trim: Sheet aluminum fabrications shown from sheet aluminum of longest available lengths.
- B. Provide concealed fasteners.
- C. Provide aluminum stiffeners and supporting members shown on drawings and as required to maintain component integrity and shape.

## **2.7 FABRICATION**

- A. Form metal parts and fit and assemble joints, except joints designed to accommodate movement. Seal joints to resist air infiltration and water penetration.
- B. Welding:
  - 1. Make welds without distorting and discoloring exposed surfaces.
  - 2. Clean and dress welds. Remove welding flux and weld spatter.
- C. Prepare and reinforce doors and frames for hardware and accessories.
  - 1. Coordinate preparation with specified hardware. See Section 08 71 00, DOOR HARDWARE.
  - 2. Fabricate reinforcement from stainless steel plates.
    - a. Hinge and pivot reinforcing: Minimum 4.5 mm (0.179 inch) thick.
    - b. Lock Face, Flush Bolts, Concealed Holders, Concealed and Surface Mounted Closers Reinforcing: Minimum 2.6 mm (0.104 inch) thick.
    - c. Other Surface Mounted Hardware Reinforcing: Minimum 1.5 mm (0.059 inch) thick.
  - 3. Where concealed hardware is specified, provide space, cutouts, and reinforcement for installation and secure fastening.
- D. Factory assemble doors.

## **2.8 FINISHES**

- A. Aluminum Anodized Finish: NAAMM AMP 500.
  - 1. Clear Anodized Finish: AA-C22A41; Class I Architectural, 0.018 mm (0.7 mil) thick.

## **2.9 ACCESSORIES**

- A. Dielectric Tape: Plastic, non-absorptive, with pressure sensitive adhesive; 0.18 to 0.25 mm (7 to 10 mils) thick.
- B. Barrier Coating: ASTM D1187/D1187M.
- C. Welding Materials: AWS D1.2/D1.2M, type to suit application.
- D. Fasteners:
  - 1. Aluminum: ASTM F468, Alloy 2024.
  - 2. Stainless Steel: ASTM F593, Alloy Groups 1, 2 and 3.
- E. Anchors: Aluminum or stainless steel; type to suit application.
- F. Galvanizing Repair Paint: MPI No. 18.
- G. Touch-Up Paint: Match shop finish.

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Examine and verify substrate suitability for product installation.
  - 1. Coordinate floor closer installation recessed into concrete slabs.
  - 2. Coordinate anchor installation built into masonry and concrete.
- B. Protect existing construction and completed work from damage.
- C. Clean substrates. Remove contaminants capable of affecting subsequently installed product's performance.
- D. Apply dielectric tape or barrier coating to aluminum surfaces in contact with dissimilar metals and cementitious materials to minimum 0.7 mm (30 mils) dry film thickness.

#### **3.2 INSTALLATION - GENERAL**

- A. Install products according to manufacturer's instructions and approved submittal drawings.
  - 1. When manufacturer's instructions deviate from specifications, submit proposed resolution for Contracting Officer's Representative consideration.
- B. Install aluminum framed entrances and storefronts plumb and true, in alignment and to lines shown on drawings.
- C. Anchor frames to adjoining construction at heads, jambs and sills.
- D. Provide concealed aluminum clips to connect adjoining frame sections.
- E. Install door hardware and hang doors. See Section 08 71 00, DOOR HARDWARE.
- F. Adjust doors and hardware uniform clearances and proper operation.
- G. Touch up damaged factory finishes.
  - 1. Repair galvanized surfaces with galvanized repair paint.
  - 2. Repair painted surfaces with touch up primer.
- H. Tolerances:
  - 1. Variation from Plumb, Level, Warp, and Bow: Maximum 3 mm in 3 m (1/8 inch in 10 feet).
  - 2. Variation from Plane: Maximum 3 mm in 3.65 m (1/8 inch in 12 feet); 6 mm (1/4 inch) over total length.
  - 3. Variation from Alignment: Maximum 1.5 mm (1/16 inch) in-line offset and maximum 3 mm (1/8 inch) corner offset.
  - 4. Variation from Square: Maximum 3 mm (1/8 inch) diagonal measurement differential.

#### **3.3 PROTECTION, CLEANING AND REPAIRING**

- A. Clean exposed aluminum and glass surfaces. Remove contaminants and stains.
- B. Protect aluminum-framed entrances and storefronts from construction operations.
- C. Remove protective materials immediately before acceptance.
- D. Repair damage.

--- E N D ---

**SECTION 08 71 00  
DOOR HARDWARE**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Door hardware and related items necessary for complete installation and operation of doors.

**1.2 RELATED WORK**

- A. Caulking: Section 07 92 00 JOINT SEALANTS.
- B. Application of Hardware: Section 08 14 00, WOOD DOORS Section 08 11 13, HOLLOW METAL DOORS AND FRAMES Section 08 41 13, ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS.
- C. Painting: Section 09 91 00, PAINTING.

**1.3 GENERAL**

- A. All hardware shall comply with UFAS, (Uniform Federal Accessible Standards) unless specified otherwise.
- B. Provide rated door hardware assemblies where required by most current version of the International Building Code (IBC).
- C. Hardware for Labeled Fire Doors and Exit Doors: Conform to requirements of NFPA 80 for labeled fire doors and to NFPA 101 for exit doors, as well as to other requirements specified. Provide hardware listed by UL, except where heavier materials, large size, or better grades are specified herein under paragraph HARDWARE SETS. In lieu of UL labeling and listing, test reports from a nationally recognized testing agency may be submitted showing that hardware has been tested in accordance with UL test methods and that it conforms to NFPA requirements.
- D. Hardware for application on metal and wood doors and frames shall be made to standard templates. Furnish templates to the fabricator of these items in sufficient time so as not to delay the construction.
- E. The following items shall be of the same manufacturer, except as otherwise specified:
  - 1. Mortise locksets.
  - 2. Hinges for hollow metal and wood doors.
  - 3. Surface applied overhead door closers.
  - 4. Exit devices.
  - 5. Floor closers.

**1.4 WARRANTY**

- A. Automatic door operators shall be subject to the terms of FAR Clause 52.246-21, except that the Warranty period shall be two years in lieu of one year for all items except as noted below:
  - 1. Locks, latchsets, and panic hardware: 5 years.
  - 2. Door closers and continuous hinges: 10 years.



### 1.5 MAINTENANCE MANUALS

- A. In accordance with Section 01 00 00, GENERAL REQUIREMENTS Article titled "INSTRUCTIONS", furnish maintenance manuals and instructions on all door hardware. Provide installation instructions with the submittal documentation.

### 1.6 SUBMITTALS

- A. Submittals shall be in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES. Submit 6 copies of the schedule per Section 01 33 23. Submit 2 final copies of the final approved schedules to VAMC Locksmith as record copies (VISN Locksmith if the VAMC does not have a locksmith).

- B. Hardware Schedule: Prepare and submit hardware schedule in the following form:

Hardware Item	Quantity	Size	Reference Publication Type No.	Finish	Mfr. Name and Catalog No.	Key Control Symbols	UL Mark (if fire rated and listed)	ANSI/BHMA Finish Designation

- C. Samples and Manufacturers' Literature:

1. Samples: All hardware items (proposed for the project) that have not been previously approved by Builders Hardware Manufacturers Association shall be submitted for approval. Tag and mark all items with manufacturer's name, catalog number and project number.
2. Samples are not required for hardware listed in the specifications by manufacturer's catalog number, if the contractor proposes to use the manufacturer's product specified.

- D. Certificate of Compliance and Test Reports: Submit certificates that hardware conforms to the requirements specified herein. Certificates shall be accompanied by copies of reports as referenced. The testing shall have been conducted either in the manufacturer's plant and certified by an independent testing laboratory or conducted in an independent laboratory, within four years of submittal of reports for approval.

### 1.7 DELIVERY AND MARKING

- A. Deliver items of hardware to job site in their original containers, complete with necessary appurtenances including screws, keys, and instructions. Tag one of each different item of hardware and deliver to COR for reference purposes. Tag shall identify items by Project Specification number and manufacturer's catalog number. These items shall remain on file in COR's office until all other similar items have been installed in project, at which time the COR will deliver items on file to Contractor for installation in predetermined locations on the project.

## 1.8 PREINSTALLATION MEETING

- A. Convene a preinstallation meeting not less than 30 days before start of installation of door hardware. Require attendance of parties directly affecting work of this section, including Contractor and Installer, Architect, Project Engineer and VA Locksmith, Hardware Consultant, and Hardware Manufacturer's Representative. Review the following:
  - 1. Inspection of door hardware.
  - 2. Job and surface readiness.
  - 3. Coordination with other work.
  - 4. Protection of hardware surfaces.
  - 5. Substrate surface protection.
  - 6. Installation.
  - 7. Adjusting.
  - 8. Repair.
  - 9. Field quality control.
  - 10. Cleaning.

## 1.9 INSTRUCTIONS

- A. Hardware Set Symbols on Drawings: Except for protective plates, door stops, mutes, thresholds and the like specified herein, hardware requirements for each door are indicated on drawings by symbols. Symbols for hardware sets consist of letters (e.g., "HW") followed by a number. Each number designates a set of hardware items applicable to a door type.
- B. Keying: All cylinders shall be keyed into existing BEST Great Grand Master Key System. Provide removable core cylinders that are removable only with a special key or tool without disassembly of knob or lockset. Cylinders shall be 7 pin type. Keying information shall be furnished at a later date by the COR.

## 1.10 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. In text, hardware items are referred to by series, types, etc., listed in such specifications and standards, except as otherwise specified.
- B. American Society for Testing and Materials (ASTM):
  - F883-04 ..... Padlocks
  - E2180-07.....Standard Test Method for Determining the Activity of Incorporated Antimicrobial Agent(s) In Polymeric or Hydrophobic Materials
- C. American National Standards Institute/Builders Hardware Manufacturers Association (ANSI/BHMA):
  - A156.1-06.....Butts and Hinges
  - A156.2-03.....Bored and Pre-assembled Locks and Latches

- A156.3-08.....Exit Devices, Coordinators, and Auto Flush Bolts
- A156.4-08.....Door Controls (Closers)
- A156.5-14.....Cylinders and Input Devices for Locks.
- A156.6-05.....Architectural Door Trim
- A156.8-05.....Door Controls-Overhead Stops and Holders
- A156.11-14.....Cabinet Locks
- A156.13-05.....Mortise Locks and Latches Series 1000
- A156.14-07 .....Sliding and Folding Door Hardware
- A156.15-06.....Release Devices-Closer Holder, Electromagnetic and  
Electromechanical
- A156.18-06.....Materials and Finishes
- A156.21-09.....Thresholds
- A156.22-05.....Door Gasketing and Edge Seal Systems
- A156.25-07 .....Electrified Locking Devices
- A156.28-07 .....Master Keying Systems
- A250.8-03.....Standard Steel Doors and Frames
- D. National Fire Protection Association (NFPA):
  - 80-10 .....Fire Doors and Other Opening Protectives
  - 101-09 .....Life Safety Code
- E. Underwriters Laboratories, Inc. (UL):
  - Building Materials Directory (2008)

## **PART 2 - PRODUCTS**

### **2.1 BUTT HINGES**

- A. ANSI A156.1. Provide only three-knuckle hinges, except five-knuckle where the required hinge type is not available in a three-knuckle version (e.g., some types of swing-clear hinges). The following types of butt hinges shall be used for the types of doors listed, except where otherwise specified:
  - 1. Exterior Doors: Type A2112/A5112 for doors 900 mm (3 feet) wide or less and Type A2111/A5111 for doors over 900 mm (3 feet) wide. Hinges for exterior outswing doors shall have non-removable pins. Hinges for exterior fire-rated doors shall be of stainless steel material.
  - 2. Interior Doors: Type A8112/A5112 for doors 900 mm (3 feet) wide or less and Type A8111/A5111 for doors over 900 mm (3 feet) wide. Hinges for doors exposed to high humidity areas (shower rooms, toilet rooms, kitchens, janitor rooms, etc. shall be of stainless steel material.
- B. Provide quantity and size of hinges per door leaf as follows:
  - 1. Doors up to 1210 mm (4 feet) high: 2 hinges.

2. Doors 1210 mm (4 feet) to 2260 mm (7 feet 5 inches) high: 3 hinges minimum.
  3. Doors greater than 2260 mm (7 feet 5 inches) high: 4 hinges.
  4. Doors up to 900 mm (3 feet) wide, standard weight: 114 mm x 114 mm (4-1/2 inches x 4-1/2 inches) hinges.
  5. Doors over 900 mm (3 feet) to 1065 mm (3 feet 6 inches) wide, standard weight: 127 mm x 114 mm (5 inches x 4-1/2 inches).
  6. Doors over 1065 mm (3 feet 6 inches) to 1210 mm (4 feet), heavy weight: 127 mm x 114 mm (5 inches x 4-1/2 inches).
  7. Provide heavy-weight hinges where specified.
  8. At doors weighing 330 kg (150 lbs.) or more, furnish 127 mm (5 inch) high hinges.
- C. See Articles "MISCELLANEOUS HARDWARE" and "HARDWARE SETS" for pivots and hinges other than butts specified above and continuous hinges specified below.

## **2.2 DOOR CLOSING DEVICES**

- A. Closing devices shall be products of one manufacturer for each type specified.

## **2.3 OVERHEAD CLOSERS**

- A. Conform to ANSI A156.4, Grade 1.
- B. Closers shall conform to the following:
1. The closer shall have minimum 50 percent adjustable closing force over minimum value for that closer and have adjustable hydraulic back check effective between 60 degrees and 85 degrees of door opening.
  2. Where specified, closer shall have hold-open feature.
  3. Size Requirements: Provide multi-size closers, sizes 1 through 6, except where multi-size closer is not available for the required application.
  4. Material of closer body shall be forged or cast.
  5. Arm and brackets for closers shall be steel, malleable iron or high strength ductile cast iron.
  6. Where closers are exposed to the exterior or are mounted in rooms that experience high humidity, provide closer body and arm assembly of stainless steel material.
  7. Closers shall have full size metal cover; plastic covers will not be accepted.
  8. Closers shall have adjustable hydraulic back-check, separate valves for closing and latching speed, adjustable back-check positioning valve, and adjustable delayed action valve.
  9. Provide closers with any accessories required for the mounting application, including (but not limited to) drop plates, special soffit plates, spacers for heavy-duty parallel arm fifth screws, bull-nose or other regular arm brackets, longer or shorter arm assemblies, and special factory templating. Provide special arms, drop plates, and templating as needed to allow mounting at doors with overhead stops and/or holders.
  10. Closer arms or backcheck valve shall not be used to stop the door from overswing, except in applications where a separate wall, floor, or overhead stop cannot be used.

11. Provide parallel arm closers with heavy duty rigid arm.
12. Where closers are to be installed on the push side of the door, provide parallel arm type except where conditions require use of top jamb arm.
13. Provide all surface closers with the same body attachment screw pattern for ease of replacement and maintenance.
14. All closers shall have a 1 ½" (38mm) minimum piston diameter.

## **2.4 DOOR STOPS**

- A. Conform to ANSI A156.16.
- B. Provide door stops wherever an opened door or any item of hardware thereon would strike a wall, column, equipment or other parts of building construction. For concrete, masonry or quarry tile construction, use lead expansion shields for mounting door stops.
- C. Where cylindrical locks with turn pieces or pushbuttons occur, equip wall bumpers Type L02251 (rubber pads having concave face) to receive turn piece or button.
- D. Provide floor stops (Type L02141 or L02161 in office areas; Type L02121 x 3 screws into floor elsewhere. Wall bumpers, where used, must be installed to impact the trim or the door within the leading half of its width. Floor stops, where used, must be installed within 4-inches of the wall face and impact the door within the leading half of its width.
- E. Where drywall partitions occur, use floor stops, Type L02141 or L02161 in office areas, Type L02121 elsewhere.
- F. Provide stop Type L02011, as applicable for exterior doors. At outswing doors where stop can be installed in concrete, provide stop mated to concrete anchor set in 76mm (3-inch) core-drilled hole and filled with quick-setting cement.
- G. Omit stops where floor mounted door holders are required and where automatic operated doors occur.
- H. Provide appropriate roller bumper for each set of doors (except where closet doors occur) where two doors would interfere with each other in swinging.
- I. Provide appropriate door mounted stop on doors in individual toilets where floor or wall mounted stops cannot be used.
- J. Provide overhead surface applied stop Type C02541, ANSI A156.8 on patient toilet doors in bedrooms where toilet door could come in contact with the bedroom door.
- K. Provide door stops on doors where combination closer magnetic holders are specified, except where wall stops cannot be used or where floor stops cannot be installed within 4-inches of the wall.
- L. Where the specified wall or floor stop cannot be used, provide concealed overhead stops (surface-mounted where concealed cannot be used).

## 2.5 OVERHEAD DOOR STOPS AND HOLDERS

- A. Conform to ANSI Standard A156.8. Overhead holders shall be of sizes recommended by holder manufacturer for each width of door. Set overhead holders for 110 degree opening, unless limited by building construction or equipment. Provide Grade 1 overhead concealed slide type: stop-only at rated doors and security doors, hold-open type with exposed hold-open on/off control at all other doors requiring overhead door stops.

## 2.6 LOCKS AND LATCHES

- A. Conform to ANSI A156.2. Locks and latches for doors 45 mm (1-3/4 inch) thick or over shall have beveled fronts. Lock cylinders shall have not less than seven pins. Cylinders for all locksets shall be removable core type. Cylinders shall be furnished with construction removable cores and construction master keys. Cylinder shall be removable by special key or tool. Construct all cores so that they will be interchangeable into the core housings of all mortise locks, rim locks, cylindrical locks, and any other type lock included in the Great Grand Master Key System. Disassembly of lever or lockset shall not be required to remove core from lockset. All locksets or latches on double doors with fire label shall have latch bolt with 19 mm (3/4 inch) throw, unless shorter throw allowed by the door manufacturer's fire label. Provide temporary keying device or construction core to allow opening and closing during construction and prior to the installation of final cores.
- B. In addition to above requirements, locks and latches shall comply with following requirements:
  - 1. Mortise Lock and Latch Sets: Conform to ANSI/BHMA A156.13. Mortise locksets shall be series 1000, minimum Grade 2. All locksets and latchsets, except on designated doors in Psychiatric (Mental Health) areas, shall have lever handles fabricated from cast stainless steel. Provide sectional (lever x rose) lever design matching [\_\_\_\_06A\_\_\_\_]. No substitute lever material shall be accepted. All locks and latchsets shall be furnished with 122.55 mm (4-7/8-inch) curved lip strike and wrought box. At outswing pairs with overlapping astragals, provide flat lip strip with 21mm (7/8-inch) lip-to-center dimension. Lock function F02 shall be furnished with emergency tools/keys for emergency entrance. All lock cases installed on lead lined doors shall be lead lined before applying final hardware finish. Furnish armored fronts for all mortise locks. Where mortise locks are installed in high-humidity locations or where exposed to the exterior on both sides of the opening, provide non-ferrous mortise lock case.
  - 2. Cylindrical Lock and Latch Sets: levers shall meet ADA (Americans with Disabilities Act) requirements. Cylindrical locksets shall be series 4000 Grade I. All locks and latchsets shall be furnished with 122.55 mm (4-7/8-inch) curved lip strike and wrought box. At outswing pairs with overlapping astragals, provide flat lip strip with 21mm (7/8-inch) lip-to-center dimension. Provide lever design to match design selected by Architect or to match existing lever design. Where two turn pieces are specified for lock F76, turn piece on inside knob shall lock and unlock inside knob, and turn piece on outside knob shall unlock outside knob when inside

knob is in the locked position. (This function is intended to allow emergency entry into these rooms without an emergency key or any special tool.)

## 2.7 ELECTRIC STRIKES

- A. ANSI/ BHMA A156.31 Grade 1.
- B. General: Use fail-secure electric strikes at fire-rated doors.

## 2.8 KEYS

- A. Stamp all keys with change number and key set symbol. Furnish keys in quantities as follows:

Locks/Keys	Quantity
Cylinder locks	2 keys each
Cylinder lock change key blanks	100 each different key way
Master-keyed sets	6 keys each
Grand Master sets	6 keys each
Great Grand Master set	5 keys
Control key	2 keys

## 2.9 KEY CABINET

- A. ANSI Standard A156.11. Provide key cabinet made of cold rolled, 1.2 mm (0.0478 inch) thick furniture steel electro-welded. Doors shall have "no sag" continuous brass-pin piano type hinge and be equipped with chrome plated locking door handles, hook cam and mechanical pushbutton door lock. Key Cabinet and Key Control System shall accommodate all keys for this project plus 25 percent. Provide minimum number of multiple cabinets where a single cabinet of largest size will not accommodate the required number of keys.
- B. Key tags shall consist of two sets: Permanent self-locking and loan key snaphook type with tag colors as follows: Red fiber marker of the permanent self-locking type approximately 32 mm (1-1/4 inch) in diameter engraved with the legend "FILE KEY MUST NOT BE LOANED." Also furnish for each hook a white cloverleaf key marker with snap-hooks engraved with the legend "LOAN KEY."
- C. The manufacturer of the lock cylinders and locks shall attach a key tag to keys of each lock cylinder and shall mark thereon the respective item number and key change number. Provide each group of keys in a key gathering envelope (supplied by Key Cabinet Manufacturer) in which the lock manufacturer shall include the following information: Item number, key change number and door number. The contractor shall furnish the Key Cabinet Manufacturer the hardware and keying schedules and change keys.
- D. The Key Cabinet Manufacturer shall set up a three-way cross index system, including master keys, listing the keys alphabetically, the hooks numerically and the key changes numerically on different colored index cards. Index cards shall be typewritten and inserted in a durable binder.

Attach the keys to the two sets of numbered tags supplied with the cabinet. (The permanent tag and the loan key tag). Instruct the owner in proper use of the system. Install cabinet as directed by the COR.

## **2.10 ARMOR PLATES, KICK PLATES, MOP PLATES AND DOOR EDGING**

- A. Conform to ANSI Standard A156.6.
- B. Provide protective plates and door edging as specified below:
  - 1. Kick plates, mop plates and armor plates of metal, Type J100 series.
  - 2. Provide kick plates and mop plates where specified. Kick plates shall be 254 mm (10 inches) or 305 mm (12 inches) high. Mop plates shall be 152 mm (6 inches) high. Both kick and mop plates shall be minimum 1.27 mm (0.050 inches) thick. Provide kick and mop plates beveled on all 4 edges (B4E). On push side of doors where jamb stop extends to floor, make kick plates 38 mm (1-1/2 inches) less than width of door, except pairs of metal doors which shall have plates 25 mm (1 inch) less than width of each door. Extend all other kick and mop plates to within 6 mm (1/4 inch) of each edge of doors. Kick and mop plates shall butt astragals. For jamb stop requirements, see specification sections pertaining to door frames.
  - 3. Kick plates and/or mop plates are not required on following door sides:
    - a. Armor plate side of doors;
    - b. Exterior side of exterior doors;
    - c. Closet side of closet doors;
    - d. Both sides of aluminum entrance doors.

## **2.11 EXIT DEVICES**

- A. Conform to ANSI Standard A156.3. Exit devices shall be Grade 1; type and function are specified in hardware sets. Provide flush with finished floor strikes for vertical rod exit devices in interior of building. Trim shall have cast satin stainless steel lever handles of design similar to locksets, unless otherwise specified. Provide key cylinders for keyed operating trim and, where specified, cylinder dogging.
- B. Concealed vertical rod panics shall be provided less bottom rod at interior doors, unless lockable or otherwise specified; provide fire pins as required by exit device and door fire labels. Where concealed vertical rod panics are specified at exterior doors, provide with both top and bottom rods.
- C. Where removable mullions are specified at pairs with rim panic devices, provide mullion with key-removable feature.
- D. At non-rated openings with panic hardware, provide panic hardware with key cylinder dogging feature.
- E. Exit devices for fire doors shall comply with Underwriters Laboratories, Inc., requirements for Fire Exit Hardware. Submit proof of compliance.



## **2.12 FLUSH BOLTS (LEVER EXTENSION)**

- A. Conform to ANSI A156.16. Flush bolts shall be Type L24081 unless otherwise specified. Furnish proper dustproof strikes conforming to ANSI A156.16, for flush bolts required on lower part of doors.
- B. Lever extension manual flush bolts shall only be used at non-fire-rated pairs for rooms only accessed by maintenance personnel.
- C. Face plates for cylindrical strikes shall be rectangular and not less than 25 mm by 63 mm (1 inch by 2-1/2 inches).
- D. Friction-fit cylindrical dustproof strikes with circular face plate may be used only where metal thresholds occur.
- E. Provide extension rods for top bolt where door height exceeds 2184 mm (7 feet 2 inches).

## **2.13 FLUSH BOLTS (AUTOMATIC)**

- A. Conform to ANSI A156.3. Dimension of flush bolts shall conform to ANSI A115. Bolts shall conform to Underwriters Laboratories, Inc., requirements for fire door hardware. Flush bolts shall automatically latch and unlatch. Furnish dustproof strikes conforming to ANSI A156.16 for bottom flushbolt. Face plates for dustproof strike shall be rectangular and not less than 38 mm by 90 mm (1-1/2 by 3-1/2 inches).
- B. At interior doors, provide auto flush bolts less bottom bolt, unless otherwise specified, except at wood pairs with fire-rating greater than 20 minutes; provide fire pins as required by auto flush bolt and door fire labels.

## **2.14 COORDINATORS**

- A. Conform to ANSI A156.16. Coordinators, when specified for fire doors, shall comply with Underwriters Laboratories, Inc., requirements for fire door hardware. Coordinator may be omitted on exterior pairs of doors where either door will close independently regardless of the position of the other door. Coordinator may be omitted on interior pairs of non-labeled open where open back strike is used. Open back strike shall not be used on labeled doors. Paint coordinators to match door frames, unless coordinators are plated. Provide bar type coordinators, except where gravity coordinators are required at acoustic pairs. For bar type coordinators, provide filler bars for full width and, as required, brackets for push-side surface mounted closers, overhead stops, and vertical rod panic strikes.

## **2.15 THRESHOLDS**

- A. Conform to ANSI A156.21, mill finish extruded aluminum, except as otherwise specified. In existing construction, thresholds shall be installed in a bed of sealant with ¼-20 stainless steel machine screws and expansion shields. In new construction, embed aluminum anchors coated with epoxy in concrete to secure thresholds. Furnish thresholds for the full width of the openings.
- B. For thresholds at elevators entrances see other sections of specifications.

- C. At exterior doors and any interior doors exposed to moisture, provide threshold with non-slip abrasive finish.
- D. Provide with miter returns where threshold extends more than 12 mm (0.5 inch) beyond face of frame.

## **2.16 WEATHERSTRIPS (FOR EXTERIOR DOORS)**

- A. Conform to ANSI A156.22. Air leakage shall not to exceed 0.50 CFM per foot of crack length (0.000774m<sup>3</sup>/s/m).

## **2.17 MISCELLANEOUS HARDWARE**

- A. Mutes: Conform to ANSI A156.16. Provide door mutes or door silencers Type L03011 or L03021, depending on frame material, of white or light gray color, on each steel or wood door frame, except at fire-rated frames, lead-lined frames and frames for sound-resistant, lightproof and electromagnetically shielded doors. Furnish 3 mutes for single doors and 2 mutes for each pair of doors, except double-acting doors. Provide 4 mutes or silencers for frames for each Dutch type door. Provide 2 mutes for each edge of sliding door which would contact door frame.

## **2.18 FINISHES**

- A. Exposed surfaces of hardware shall have ANSI A156.18, finishes as specified below. Finishes on all hinges, pivots, closers, thresholds, etc., shall be as specified below under "Miscellaneous Finishes." For field painting (final coat) of ferrous hardware, see Section 09 91 00, PAINTING.
- B. 626 or 630: All surfaces on exterior and interior of buildings, except where other finishes are specified.
- C. Miscellaneous Finishes:
  - 1. Hinges --exterior doors: 626 or 630.
  - 2. Hinges --interior doors: 652 or 630.
  - 3. Door Closers: Factory applied paint finish. Dull or Satin Aluminum color.
  - 4. Thresholds: Mill finish aluminum.
  - 5. Other primed steel hardware: 600.
- D. Anti-microbial Coating: All hand-operated hardware (levers, pulls, push bars, push plates, paddles, and panic bars) shall be provided with an anti-microbial/anti-fungal coating that has passed ASTM E2180 tests. Coating to consist of ionic silver (Ag+). Silver ions surround bacterial cells, inhibiting growth of bacteria, mold, and mildew by blockading food and respiration supplies.

## **2.19 BASE METALS**

- A. Apply specified U.S. Standard finishes on different base metals as following:

Finish	Base Metal
652	Steel
626	Brass or bronze
630	Stainless steel

### **PART 3 - EXECUTION**

#### **3.1 HARDWARE HEIGHTS**

- A. For new buildings locate hardware on doors at heights specified below, with all hand-operated hardware centered within 864 mm (34 inches) to 1200 mm (48 inches), unless otherwise noted:
- B. Hardware Heights from Finished Floor:
1. Exit devices centerline of strike (where applicable) 1024 mm (40-5/16 inches).
  2. Locksets and latch sets centerline of strike 1024 mm (40-5/16 inches).
  3. Deadlocks centerline of strike 1219 mm (48 inches).
  4. Hospital arm pull 1168 mm (46 inches) to centerline of bottom supporting bracket.
  5. Centerline of door pulls to be 1016 mm (40 inches).
  6. Push plates and push-pull shall be 1270 mm (50 inches) to top of plate.
  7. Push-pull latch to be 1024 mm (40-5/16 inches) to centerline of strike.
  8. Locate other hardware at standard commercial heights. Locate push and pull plates to prevent conflict with other hardware.

#### **3.2 INSTALLATION**

- A. Closer devices, including those with hold-open features, shall be equipped and mounted to provide maximum door opening permitted by building construction or equipment. Closers shall be mounted on side of door inside rooms, inside stairs, and away from corridors. At exterior doors, closers shall be mounted on interior side. Where closers are mounted on doors they shall be mounted with sex nuts and bolts; foot shall be fastened to frame with machine screws.
- B. Hinge Size Requirements:

<b>Door Thickness</b>	<b>Door Width</b>	<b>Hinge Height</b>
45 mm (1-3/4 inch)	900 mm (3 feet) and less	113 mm (4-1/2 inches)
45 mm (1-3/4 inch)	Over 900 mm (3 feet) but not more than 1200 mm (4 feet)	125 mm (5 inches)
35 mm (1-3/8 inch) (hollow core wood doors)	Not over 1200 mm (4 feet)	113 mm (4-1/2 inches)

- C. Hinge leaves shall be sufficiently wide to allow doors to swing clear of door frame trim and surrounding conditions.
- D. Where new hinges are specified for new doors in existing frames or existing doors in new frames, sizes of new hinges shall match sizes of existing hinges; or, contractor may reuse existing hinges provided hinges are restored to satisfactory operating condition as approved by COR. Existing hinges shall not be reused on door openings having new doors and new frames. Coordinate preparation for hinge cut-outs and screw-hole locations on doors and frames.

E. Hinges Required Per Door:

Doors 1500 mm (5 ft) or less in height	2 butts
Doors over 1500 mm (5 ft) high and not over 2280 mm (7 ft 6 in) high	3 butts
Doors over 2280 mm (7 feet 6 inches) high	4 butts
Dutch type doors	4 butts
Doors with spring hinges 1370 mm (4 feet 6 inches) high or less	2 butts
Doors with spring hinges over 1370 mm (4 feet 6 inches)	3 butts

- F. Fastenings: Suitable size and type and shall harmonize with hardware as to material and finish. Provide machine screws and lead expansion shields to secure hardware to concrete, ceramic or quarry floor tile, or solid masonry. Fiber or rawl plugs and adhesives are not permitted. All fastenings exposed to weather shall be of nonferrous metal.
- G. After locks have been installed; show in presence of COR that keys operate their respective locks in accordance with keying requirements. (All keys, Master Key level and above shall be sent Registered Mail to the Medical Center Director along with the bitting list. Also a copy of the invoice shall be sent to the COR for his records.) Installation of locks which do not meet specified keying requirements shall be considered sufficient justification for rejection and replacement of all locks installed on project.

### 3.3 FINAL INSPECTION

- A. Installer to provide letter to VA Resident/Project Engineer that upon completion, installer has visited the Project and has accomplished the following:
1. Re-adjust hardware.
  2. Evaluate maintenance procedures and recommend changes or additions, and instruct VA personnel.
  3. Identify items that have deteriorated or failed.
  4. Submit written report identifying problems.

### 3.4 DEMONSTRATION

- A. Demonstrate efficacy of mechanical hardware and electrical, and electronic hardware systems, including adjustment and maintenance procedures, to satisfaction of Resident/Project Engineer and VA Locksmith.

### 3.5 HARDWARE SETS

Hardware Group No. 01

For use on mark/door#(s):

500A

Each To Have:

Qty		Description	Catalog Number	Finish
6	EA	HW HINGE	A5111	630
1	EA	PANIC HARDWARE	Grade 1, Type 8, Function 01	626AM
1	EA	PANIC HARDWARE	Grade 1, Type 8, Function 03	626AM
2	EA	SFIC MORTISE CYL.	MORTISE CYLINDER	626
1	EA	SFIC RIM CYLINDER	RIM CYLINDER	626
3	EA	COMBINATED SFIC	CORE	626
2	EA	90 DEG OFFSET PULL	8190HD 10"	630AM
2	EA	OH STOP	C01541	630
2	EA	DOOR SWEEP	R3A534	AA
1	EA	THRESHOLD	J32100	A

Weatherstripping by door mfg. Door requires special undercut for ADA type thresholds.

Hardware Group No. 02

For use on mark/door#(s):

500

Each To Have:

Qty		Description	Catalog Number	Finish
3	EA	HW HINGE	A8111	652
1	EA	STOREROOM LOCK	F86	626AM
1	EA	COMBINATED SFIC	CORE	626
1	EA	SURFACE CLOSER	C02011/C02041 PT-4A, PT-4C, PT-4D, PT-4H	689
1	EA	KICK PLATE	J102	630
1	EA	WALL STOP	L52101	630
1	EA	GASKETING	R0E154	S-Bk

Hardware Group No. 03

For use on mark/door#(s):  
502

Each To Have:

Qty		Description	Catalog Number	Finish
3	EA	HW HINGE	A8111	652
1	EA	PRIVACY LOCK	F76	626AM
1	EA	SURFACE CLOSER	C02011/C02041 PT-4A, PT-4C, PT-4D, PT-4H	689
1	EA	KICK PLATE	J102	630
1	EA	MOP PLATE	J103	630
1	EA	WALL STOP	L52101	630
3	EA	SILENCER	L03011	GRY

--- E N D ---

**SECTION 08 80 00  
GLAZING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

- A. This section specifies the following:
  - 1. Glass.
  - 2. Glazing materials and accessories for both factory and field glazed assemblies.

**1.2 RELATED WORK:**

- A. Factory glazed by manufacturer in following units:
  - 1. Glazed Curtain Walls: Section 08 41 13, ALUMINUM FRAMED ENTRANCES AND STOREFRONTS.

**1.3 LABELS:**

- A. Temporary labels:
  - 1. Provide temporary label on each light of glass identifying manufacturer or brand and glass type, quality and nominal thickness.
  - 2. Label in accordance with NFRC label requirements.
  - 3. Temporary labels are to remain intact until glass is approved by Contracting Officer Representative (COR).
- B. Permanent labels:
  - 1. Locate in corner for each pane.
  - 2. Label in accordance with ANSI Z97.1 and SGCC label requirements.
    - a. Tempered glass.
    - b. Laminated glass or have certificate for panes without permanent label.
    - c. Organic coated glass.
  - 3. Fire rated glazing assemblies: Mark in accordance with IBC.

**1.4 PERFORMANCE REQUIREMENTS:**

- A. General: Design glazing system consistent with guidance and practices presented in the GANA Glazing Manual, GANA Laminated Glazing Manual, and GANA Sealant Manual, as applicable to project. Installed glazing is to withstand applied loads, thermal stresses, thermal movements, building movements, permitted tolerances, and combinations of these conditions without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; unsafe engagement of the framing system; deflections beyond specified limits; or other defects in construction.
- B. Glazing Unit Design: Design glass, including engineering analysis meeting requirements of authorities having jurisdiction. Thicknesses listed are minimum. Coordinate thicknesses with framing system manufacturers.

1. Design glass in accordance with ASTM E1300, and for conditions beyond the scope of ASTM E1300, by a properly substantiated structural analysis.
2. Design Wind Pressures: In accordance with applicable code .
3. Wind Design Data: In accordance with applicable code .
4. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than the structural capacity of the glazing unit, the threshold at which frame engagement is no longer safely assured, 1/100 times the short-side length, or 19 mm (0.75 inch), whichever is less.

E. Building Enclosure Vapor Retarder and Air Barrier:

1. Utilize the inner pane of multiple pane sealed units for the continuity of the air barrier and vapor retarder seal.
2. Maintain a continuous air barrier and vapor retarder throughout the glazed assembly from glass pane to heel bead of glazing sealant.

**1.5 SUBMITTALS:**

A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Sustainable Design Submittals, as described below:

1. Volatile organic compounds per volume as specified in PART 2 – PRODUCTS.

C. Manufacturer's Certificates:

1. Certificate stating that fire-protection and fire-resistive glazing units meet code requirements for fire-resistance-rated assembly and applicable safety glazing requirements.
2. Certificate on solar heat gain coefficient when value is specified.
3. Certificate on "R" value when value is specified.
4. Certificate test reports confirming compliance with specified bullet resistive rating.
5. Certificate that blast resistant glass meets the specified requirements.

D. Manufacturer Warranty.

E. Manufacturer's Literature and Data:

1. Glass, each kind required.
2. Insulating glass units.
3. Transparent (one-way vision glass) mirrors.
4. Elastic compound for metal sash glazing.
5. Putty, for wood sash glazing.
6. Glazing cushion.
7. Sealing compound.

F. Samples:

1. Size: 305 mm by 305 mm (12 inches by 12 inches).



2. Tinted glass.
  3. Reflective glass.
- G. Preconstruction Adhesion and Compatibility Test Report: Submit glazing sealant manufacturer's test report indicating glazing sealants were tested for adhesion to glass and glazing channel substrates and for compatibility with glass and other glazing materials.

**1.6 DELIVERY, STORAGE AND HANDLING:**

- A. Delivery: Schedule delivery to coincide with glazing schedules so minimum handling of crates is required. Do not open crates except as required for inspection for shipping damage.
- B. Storage: Store cases according to printed instructions on case, in areas least subject to traffic or falling objects. Keep storage area clean and dry.
- C. Handling: Unpack cases following printed instructions on case. Stack individual windows on edge leaned slightly against upright supports with separators between each.
- D. Protect laminated security glazing units against face and edge damage during entire sequence of fabrication, handling, and delivery to installation location. Provide protective covering on exposed faces of glazing plastics, and mark inside as "INTERIOR FACE" or "PROTECTED FACE":
  1. Treat security glazing as fragile merchandise, and packaged and shipped in export wood cases with width end in upright position and blocked together in a mass. Storage and handling to comply with manufacturer's directions and as required to prevent edge damage or other damage to glazing resulting from effects of moisture, condensation, temperature changes, direct exposure to sun, other environmental conditions, and contact with chemical solvents.
  2. Protect sealed-air-space insulating glazing units from exposure to abnormal pressure changes, as could result from substantial changes in altitude during delivery by air freight. Provide temporary breather tubes which do not nullify applicable warranties on hermetic seals.
  3. Temporary protections: The glass front and polycarbonate back of glazing are to be temporarily protected with compatible, peelable, heat-resistant film which will be peeled for inspections and re-applied and finally removed after doors and windows are installed at destination. Since many adhesives will attack polycarbonate, the film used on exposed polycarbonate surfaces is to be approved and applied by manufacturer.
  4. Edge protection: To cushion and protect glass clad, and polycarbonate edges from contamination or foreign matter, the four (4) edges are to be sealed the depth of glazing with continuous standard-thickness thermoplastic rubber tape. Alternatively, continuous channel shaped extrusion of thermoplastic rubber are to be used, with flanges extending into face sides of glazing.
  5. Protect "Constant Temperature" units including every unit where glass sheet is directly laminated to or directly sealed with metal-tube type spacer bar to polycarbonate sheet, from

exposures to ambient temperatures outside the range of 16 to 24 degrees C (60 to 75 degrees F), during the fabricating, handling, shipping, storing, installation, and subsequent protection of glazing.

#### **1.7 PROJECT CONDITIONS:**

Field Measurements: Field measure openings before ordering tempered glass products to assure for proper fit of field measured products.

#### **1.8 WARRANTY:**

- A. Construction Warranty: Comply with the FAR clause 52.246-21 "Warranty of Construction".
- B. Manufacturer Warranty: Manufacturer shall warranty their glazing from the date of installation and final acceptance by the Government as follows. Submit manufacturer warranty.
  - 2. Insulating glass units to remain sealed for ten (10) years.

#### **1.9 APPLICABLE PUBLICATIONS:**

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Architectural Manufacturers Association (AAMA):
  - 800 ..... Test Methods for Sealants
  - 810.1-77 ..... Expanded Cellular Glazing Tape
- C. American National Standards Institute (ANSI):
  - Z97.1-14 ..... Safety Glazing Material Used in Building - Safety Performance Specifications and Methods of Test
- D. American Society of Civil Engineers (ASCE):
  - 7-10 ..... Wind Load Provisions
- E. ASTM International (ASTM):
  - C542-05(R2011) ..... Lock-Strip Gaskets
  - C716-06 ..... Installing Lock-Strip Gaskets and Infill Glazing Materials
  - C794-10 ..... Adhesion-in-Peel of Elastomeric Joint Sealants
  - C864-05(R2011) ..... Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers
  - C920-14a ..... Elastomeric Joint Sealants
  - C964-07(R2012) ..... Standard Guide for Lock-Strip Gasket Glazing
  - C1036-11(R2012) ..... Flat Glass
  - C1048-12 ..... Heat-Treated Flat Glass-Kind HS, Kind FT Coated and Uncoated Glass.
  - C1172-14 ..... Laminated Architectural Flat Glass
  - C1349-10 ..... Standard Specification for Architectural Flat Glass Clad Polycarbonate
  - C1376-10 ..... Pyrolytic and Vacuum Deposition Coatings on Flat Glass

- D635-10 ..... Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastic in a Horizontal Position
- D4802-10 ..... Poly (Methyl Methacrylate) Acrylic Plastic Sheet
- E84-14..... Surface Burning Characteristics of Building Materials
- E119-14..... Standard Test Methods for Fire Test of Building Construction and Material
- E1300-12a..... Load Resistance of Glass in Buildings
- E1886-13a..... Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials
- E1996-14a..... Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes
- E2141-12..... Test Methods for Assessing the Durability of Absorptive Electrochromic Coatings on Sealed Insulating Glass Units
- E2190-10..... Insulating Glass Unit
- E2240-06..... Test Method for Assessing the Current-Voltage Cycling Stability at 90 Degree C (194 Degree F) of Absorptive Electrochromic Coatings on Sealed Insulating Glass Units
- E2241-06..... Test Method for Assessing the Current-Voltage Cycling Stability at Room Temperature of Absorptive Electrochromic Coatings on Sealed Insulating Glass Units
- E2354-10..... Assessing the Durability of Absorptive Electrochromic Coatings within Sealed Insulating Glass Units
- E2355-10..... Test Method for Measuring the Visible Light Transmission Uniformity of an Absorptive Electrochromic Coating on a Glazing Surface
- F1233-08..... Standard Test Method for Security Glazing Materials and Systems
- F1642-12..... Test Method for Glazing and Glazing Systems Subject to Airblast Loadings
- E. Code of Federal Regulations (CFR):
  - 16 CFR 1201-10..... Safety Standard for Architectural Glazing Materials
- F. Glass Association of North America (GANA):
  - 2010 Edition ..... GANA Glazing Manual
  - 2008 Edition ..... GANA Sealant Manual
  - 2009 Edition ..... GANA Laminated Glazing Reference Manual

- 2010 Edition ..... GANA Protective Glazing Reference Manual
- G. International Code Council (ICC):  
IBC ..... International Building Code
- H. Insulating Glass Certification Council (IGCC)
- I. Insulating Glass Manufacturer Alliance (IGMA):  
TB-3001-13 ..... Guidelines for Sloped Glazing  
TM-3000 ..... North American Glazing Guidelines for Sealed Insulating Glass  
Units for Commercial and Residential Use
- J. Intertek Testing Services – Warnock Hersey (ITS-WHI)
- K. National Fire Protection Association (NFPA):  
80-16 ..... Fire Doors and Windows  
252-12 ..... Fire Tests of Door Assemblies  
257-12 ..... Standard on Fire Test for Window and Glass Block Assemblies
- L. National Fenestration Rating Council (NFRC)
- M. Safety Glazing Certification Council (SGCC) 2012:  
Certified Products Directory (Issued Semi-Annually).
- N. Underwriters Laboratories, Inc. (UL):  
9-08(R2009) ..... Fire Tests of Window Assemblies  
263-14 ..... Fire Tests of Building Construction and Materials  
752-11 ..... Bullet-Resisting Equipment.
- O. Unified Facilities Criteria (UFC):  
4-010-01-03(R2007)..... DOD Minimum Antiterrorism Standards for Buildings
- P. U.S. Veterans Administration:  
Physical Security Design Manual for VA Facilities (VAPSDG); Life Safety Protected  
Physical Security Design Manual for VA Facilities (VAPSDG); Mission Critical Facilities  
Architectural Design Manual for VA Facilities (VASDM)
- Q. Environmental Protection Agency (EPA):  
40 CFR 59(2014) ..... National Volatile Organic Compound Emission Standards for  
Consumer and Commercial Products

## **PART 2 - PRODUCT**

### **2.1 GLASS:**

- A. Provide minimum thickness stated and as additionally required to meet performance requirements.
1. Provide minimum 6 mm (1/4 inch) thick glass units unless otherwise indicated.
- B. Obtain glass units from single source from single manufacturer for each glass type.
- C. Clear Glass:
1. ASTM C1036, Type I, Class 1, Quality q3 .

E. Tinted Heat reflective and low emissivity coated glass:

1. ASTM C1036, Type I, Class 2, Quality q3.

## **2.2 HEAT-TREATED GLASS:**

D. Clear Tempered Glass:

1. ASTM C1048, Kind FT, Condition A, Type I, Class 1, Quality q3.

## **2.3 INSULATING GLASS UNITS:**

- A. Provide factory fabricated, hermetically sealed glass unit consisting of two panes of glass separated by a dehydrated air space and comply with ASTM E2190.
- B. Assemble units using glass types specified in Insulating Glass Schedule.

## **2.4 GLAZING ACCESSORIES:**

- A. As required to supplement the accessories provided with the items to be glazed and to provide a complete installation. Ferrous metal accessories exposed in the finished work are to have a finish that will not corrode or stain while in service. Fire rated glazing to be installed with glazing accessories in accordance with the manufacturer's installation instructions.
- B. Setting Blocks: ASTM C864:
  1. Silicone type.
  2. Channel shape; having 6 mm (1/4 inch) internal depth.
  3. Shore A hardness of 80 to 90 Durometer.
  4. Block lengths: 50 mm (2 inches) except 100 to 150 mm (4 to 6 inches) for insulating glass.
  5. Block width: Approximately 1.6 mm (1/16 inch) less than the full width of the rabbet.
  6. Block thickness: Minimum 4.8 mm (3/16 inch). Thickness sized for rabbet depth as required.
- C. Spacers: ASTM C864:
  1. Channel shape having a 6 mm (1/4 inch) internal depth.
  2. Flanges not less 2.4 mm (3/32 inch) thick and web 3 mm (1/8 inch) thick.
  3. Lengths: 25 to 76 mm (1 to 3 inches).
  4. Shore A hardness of 40 to 50 Durometer.
- D. Glazing Tapes:
  1. Semi-solid polymeric based closed cell material exhibiting pressure-sensitive adhesion and withstanding exposure to sunlight, moisture, heat, cold, and aging.
  2. Shape, size and degree of softness and strength suitable for use in glazing application to prevent water infiltration.
  3. Complying with AAMA 800 for the following types:
    - a. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.

- b. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.
- E. Spring Steel Spacer: Galvanized steel wire or strip designed to position glazing in channel or rabbeted sash with stops.
- H. Glazing Gaskets: ASTM C864:
  - 1. Firm dense wedge shape for locking in sash.
  - 2. Soft, closed cell with locking key for sash key.
  - 3. Flanges may terminate above the glazing-beads or terminate flush with top of beads.
- I. Lock-Strip Glazing Gaskets: ASTM C542, shape, size, and mounting as indicated.
- J. Glazing Sealants: ASTM C920, silicone neutral cure:
  - 1. Type S.
  - 2. Class 25 or 50 as recommended by manufacturer for application.
  - 3. Grade NS.
  - 4. Shore A hardness of 25 to 30 Durometer.
  - 5. VOC Content: For sealants used inside the weatherproofing system, not more than 250 g/L or less when calculating according to 40 CFR 59, (EPA Method 24).
- L. Neoprene, EPDM, or Vinyl Glazing Gasket: ASTM C864.
  - 1. Channel shape; flanges may terminate above the glazing channel or flush with the top of the channel.
  - 2. Designed for dry glazing.
- M. Color:
  - 1. Color of glazing compounds, gaskets, and sealants used for aluminum color frames to match color of the finished aluminum and be nonstaining.
  - 2. Color of other glazing compounds, gaskets, and sealants which will be exposed in the finished work and unpainted are to be black, gray, or neutral color.
- N. Smoke Removal Unit Targets: Adhesive targets affixed to glass to identify glass units intended for removal for smoke control. Comply with requirements of local Fire Department.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION:**

- A. Verification of Conditions:
  - 1. Examine openings for glass and glazing units; determine they are proper size; plumb; square; and level before installation is started.
  - 2. Verify that glazing openings conform with details, dimensions and tolerances indicated on manufacturer is approved shop drawings.

- B. Review for conditions which may adversely affect glass and glazing unit installation, prior to commencement of installation. Do not proceed with installation until unsatisfactory conditions have been corrected.
- C. Verify that wash down of adjacent masonry is completed prior to erection of glass and glazing units.

### **3.2 PREPARATION:**

- A. For sealant glazing, prepare glazing surfaces in accordance with GANA Sealant Manual.
- B. Determine glazing unit size and edge clearances by measuring the actual unit to receive the glazing.
- C. Shop fabricate and cut glass with smooth, straight edges of full size required by openings to provide GANA recommended edge clearances.
- D. Verify that components used are compatible.
- E. Clean and dry glazing surfaces.
- F. Prime surfaces scheduled to receive sealants, as determined by preconstruction sealant-substrate testing.

### **3.3 INSTALLATION – GENERAL:**

- A. Install in accordance with GANA Glazing Manual, GANA Sealant Manual, IGMA TB-3001, and IGMA TM-3000 unless specified otherwise.
- B. Glaze in accordance with recommendations of glazing and framing manufacturers, and as required to meet the Performance Test Requirements specified in other applicable sections of specifications.
- C. Set glazing without bending, twisting, or forcing of units.
- D. Do not allow glass to rest on or contact any framing member.
- E. Glaze doors and operable sash, in a securely fixed or closed and locked position, until sealant, glazing compound, or putty has thoroughly set.
- G. Tempered Glass: Install with roller distortions in horizontal position unless otherwise directed.
- K. Insulating Glass Units:
  - 1. Glaze in compliance with glass manufacturer's written instructions.
  - 2. When glazing gaskets are used, they are to be of sufficient size and depth to cover glass seal or metal channel frame completely.
  - 3. Do not use putty or glazing compounds.
  - 4. Do not grind, nip, cut, or otherwise alter edges and corners of fused glass units after shipping from factory.
  - 5. Install with tape or gunnable sealant in wood sash.
- L. Fire Protective and Fire Resistance Glass:
  - 1. Wire Glass: Glaze in accordance with NFPA 80.

2. Other fire protective and fire resistant glass: Glaze in accordance with manufacturer's installation instructions and NFPA 80.

### **3.6 INSTALLATION - WET/DRY METHOD (PREFORMED TAPE AND SEALANT)**

- A. Cut glazing tape to length and set against permanent stops, 5 mm (3/16 inch) below sight line. Seal corners by butting tape and dabbing with butyl sealant.
- B. Apply heel bead of butyl sealant along intersection of permanent stop with frame ensuring full perimeter seal between glass and frame to complete the continuity of the air and vapor seal.
- C. Place setting blocks at  $1/4$   $1/3$  points with edge block no more than 152 mm (6 inches) from corners.
- D. Rest glazing on setting blocks and push against tape and heel bead of sealant with sufficient pressure to achieve full contact at perimeter of pane or glass unit.
- E. Install removable stops, with spacer strips inserted between glazing and applied stops, 6 mm (1/4 inch) below sight line. Place glazing tape on glazing pane or unit with tape flush with sight line.
- F. Fill gap between glazing and stop with sealant to depth equal to bite of frame on glazing, but not more than 9 mm (3/8 inch) below sight line. Sealant type is to be compatible with glazing tape.
- G. Apply cap bead of sealant along void between the stop and the glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

### **3.9 INSTALLATION - INTERIOR WET/DRY METHOD (TAPE AND SEALANT):**

- A. Cut glazing tape to length and install against permanent stops, projecting 1.6 mm (1/16 inch) above sight line.
- B. Place setting blocks at  $1/4$   $1/3$  points with edge block no more than 150 mm (6 inches) from corners.
- C. Rest glazing on setting blocks and push against tape to ensure full contact at perimeter of pane or unit.
- D. Install removable stops, spacer shims inserted between glazing and applied stops at 600 mm (24 inch) intervals, 6 mm (1/4 inch) below sight line.
- E. Fill gaps between pane and applied stop with sealant to depth equal to bite on glazing, to uniform and level line. Sealant type is to be compatible with glazing tape.
- F. Trim protruding tape edge.

### **3.13 REPLACEMENT AND CLEANING:**

- A. Clean new glass surfaces removing temporary labels, paint spots, and defacement after approval by COR.
- B. Replace cracked, broken, and imperfect glass, or glass which has been installed improperly.
- C. Leave glass, putty, and other setting material in clean, whole, and acceptable condition.



**3.14 PROTECTION:**

- A. Protect finished surfaces from damage during erection, and after completion of work. Strippable plastic coatings on colored anodized finish are not acceptable.

**3.17 INSULATING GLASS SCHEDULE:**

- A. Provide factory fabricated, hermetically sealed glass unit consisting of two panes of glass separated by a dehydrated air space and comply with ASTM E2190.
- B. Assemble units using glass types specified:
- C. Sealed Edge Units (SEU):
  - 1. Tempered Insulating Glass Unit Makeup IG-1T
    - a. Outboard Lite
      - 1. Glass type: Class 2 (clear)
      - 2. Glass Tint: Clear
      - 3. Nominal Thickness: 6.0 mm (1/4 inch)
      - 4. Glass Strength: (Fully-tempered)
      - 5. Low-E Coating Orientation: (Surface # 2\_)
    - b. Spacer
      - 1. Nominal Thickness: 12 mm (1/2 inch)
      - 2. Gas Fill: (90% Argon)
    - c. Inboard Lite
      - 1. Glass Type: Class 1 (clear) float.
      - 2. Glass Tint: Clear.
      - 3. Nominal Thickness: 6mm (1/4 inch).
      - 4. Glass Strength: (Tempered)
      - 5. Coating Orientation: (N/A)
  - 3. Performance Characteristics (Center of Glass)
    - a. Visible Transmittance: 64%
    - b. Visible Reflectance: 12%
    - c. Winter U-factor (U-value): .28
    - d. Shading Coefficient (SC): .32
    - e. Solar heat Gain Coefficient (SHGC): .27
  - 6. Glass shall be annealed, heat strengthened or tempered as required by codes, or as required to meet thermal stress and wind loads.
  - 7. Glass heat-treated by horizontal (roller hearth) process with inherent roller wave distortion parallel to the bottom edge of the glass as installed when specified.

--- E N D ---

**SECTION 09 05 16**  
**SUBSURFACE PREPARATION FOR FLOOR FINISHES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies subsurface preparation requirements for areas to receive the installation of applied. This section includes testing concrete for moisture and pH, remedial floor coating for concrete floor slabs having unsatisfactory moisture or pH conditions, floor leveling and repair as required.

**1.2 RELATED WORK**

- A. Section 07 92 00, JOINT SEALANTS.
- B. Section 09 65 19, RESILIENT TILE FLOORING

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA and TEST DATA.
- B. Written approval confirming product compatibility with subfloor material manufacturer and the flooring manufacturer
- C. Product Data:
  - 1. Moisture remediation system
  - 2. Underlayment Primer
  - 3. Cementitious Self-Leveling Underlayment
- D. Test Data:
  - 1. Moisture test and pH results performed by a qualified independent testing agency or warranty holding manufacturer's technical representative.

**1.4 DELIVERY AND STORAGE**

- A. Deliver materials in containers with labels legible and intact and grade-seals unbroken.
- B. Store material to prevent damage or contamination.

**1.5 APPLICABLE PUBLICATIONS**

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in text by basic designation only.
- B. American Society for Testing and Materials (ASTM):

<b>D638-10</b> (2010)	Test Method for Tensile Properties of Plastics
<b>D4259-88</b> (2012)	Standard Practice for Abrading Concrete to alter the surface profile of the concrete and to remove foreign materials and weak surface laitance.
<b>C109/C109M</b> -12 (2012)	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens) Modified Air Cure Only
<b>D7234-12</b> (2012)	Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers.

<b>E96/E96M - 12</b> <b>(2012)</b>	Standard Test Methods for Water Vapor Transmission of Materials
<b>F710-11</b> <b>(2011)</b>	Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
<b>F1869-11</b> <b>(2011)</b>	Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
<b>F2170-11</b> <b>(2011)</b>	Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes
<b>C348-08</b> <b>(2008)</b>	Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars
<b>C191-13</b> <b>(2013)</b>	Standard Test Method for Time of Setting of Hydraulic Cement by Vicat Needle

## PART 2 - PRODUCTS

### 2.1 MOISTURE REMEDIATION COATING

- A. System Descriptions:
  - 1. High-solids, epoxy system designed to suppress excess moisture in concrete prior to an overlayment. For use under, Vinyl tile, tile and carpet where issues caused by moisture vapor are a concern.
- B. Products: Subject to compliance with applicable fire, health, environmental, and safety requirements for storage, handling, installation, and clean up.
- C. System Components: Verify specific requirements as systems vary by manufacturer. Verify build up layers and installation method. Verify compatibility with substrate. Use manufacturer's standard components, compatible with each other and as follows:
  - 1. Liquid applied coating:
    - a. Resin: epoxy.
    - b. Formulation Description: Multiple component high solids.
    - c. Application: Per manufacturer's written installation requirements.
    - d. Thickness: minimum 10 mils
- D. Material Vapor Permeance: Application shall achieve a permeance rating of less than 0.1 perm in accordance with ASTM E96/E96M.
- E. Maximum RH requirement: 100% testing in accordance with ASTM F2170.

Property	Test	Value
Tensile Strength	ASTM D638	4,400 psi
Volatile Organic Compound Limits (V.O.C.)	SCAMD Rule 1113	25 grams per liter
Permeance	ASTM E96	0.1 perms
Tensile Modulus	ASTM D638	1.9X10 <sup>5</sup> psi

Percent Elongation	ASTM D638	12%
Cure Rate	Per manufacture's Data	4 hours Tack free with 24hr recoat window
Bond Strength	ASTM D7234	100% bond to concrete failure

## 2.2 CEMENTITIOUS SELF-LEVELING UNDERLAYMENT

- A. System Descriptions:
  - 1. High performance self-leveling underlayment resurfacer. Single component, self-leveling, cementitious material designed for easy application as an underlayment for all types of flooring materials. It is used for substrate repair and leveling.
- B. Products: Subject to compliance with applicable fire, health, environmental, and safety requirements for storage, handling, installation, and clean up. Gypsum-based products are unacceptable.
- C. System Characteristics:
  - 1. Wearing Surface: smooth
  - 2. Thickness: Per architectural drawings, ranging from feathered edge to 1", per application. Applications greater than 1" require additional 3/8" aggregate to mix or as recommended by manufacturer.
- D. Underlayment shall be calcium aluminate cement-based, containing Portland cement. Gypsum-based products are unacceptable.
- E. Compressive Strength: Minimum 4100 psi in 28 days in accordance with ASTM C109/C109M.
- F. Flexural Strength: Minimum 1000 psi in 28 days in accordance with ASTM C348
- G. Dry Time: Underlayment shall receive the application of floor coverings in 16 hours.
- H. Primer: compatible and as recommended by manufacturer for use over intended substrate
- I. System Components: Manufacturer's standard components that are compatible with each other and as follows:
  - 1. Primer:
    - a. Resin: copolymer
    - b. Formulation Description: single component ready to use.
    - c. Application Method: Squeegee and medium nap roller.  
All puddles shall be removed, and material shall be allowed to dry, 1-2 hours at 70F/21C.
    - d. Number of Coats: (1) one.
  - 2. Grout Resurfacing Base:

- a. Formulation Description: Single component, cementitious self-leveling high-early and high-ultimate strength grout.
- b. Application Method: colloidal mix pump, cam rake, spike roll.
  - 1) Thickness of Coats: Per architectural scope, 1" lifts.
  - 2) Number of Coats: More than one if needed.
- c. Aggregates: for applications greater than 1inch, require additional 3/8" aggregate to mix.

Property	Test	Value
Compressive Strength	ASTM C109/C109M	2,200 psi @ 24 hrs 3,000 psi @ 7 days
Initial set time Final Set time	ASTM C191	30-45 min. 1 to 1.5 hours
Bond Strength	ASTM D7234	100% bond to concrete failure

### **PART 3 - EXECUTION**

#### **3.1 ENVIRONMENTAL REQUIREMENTS**

- A. Maintain ambient temperature of work areas at not less than 16 degree C (60 degrees F), without interruption, for not less than 24 hours before testing and not less than three days after testing.
- B. Maintain higher temperatures for a longer period of time where required by manufacturer's recommendation.
- C. Do not install materials when the temperatures of the substrate or materials are not within 60-85 degrees F/ 16-30 degrees C.

#### **3.2 SURFACE PREPARATION**

- A. Existing concrete slabs with existing floor coverings:
  - 1. Conduct visual observation of existing floor covering for adhesion, water damage, alkaline deposits, and other defects.
  - 2. Remove existing floor covering and adhesives. Comply with local, state and federal regulations and the RFCI Recommended Work Practices for Removal of Resilient Floor Coverings, as applicable to the floor covering being removed.
- B. Concrete shall meet the requirements of ASTM F710 and be sound, solid, clean, and free of all oil, grease, dirt, curing compounds, and any substance that might act as a bond-breaker before application. As required prepare slab by mechanical methods. No chemicals or solvents shall be used.
- C. General: Prepare and clean substrates according to flooring manufacturer's written instructions for substrate indicated.
- D. Prepare concrete substrates per ASTM D4259 as follows:
  - 1. Dry abrasive blasting.
  - 2. Wet abrasive blasting.
  - 3. Vacuum-assisted abrasive blasting.

4. Centrifugal-shot abrasive blasting.
5. Comply with manufacturer's written instructions.
- E. Repair damaged and deteriorated concrete according to flooring manufacturer's written recommendations.
- F. Verify that concrete substrates are dry.
- G. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application only after substrates have maximum moisture-vapor-emission rate of per flooring manufacturer's formal and project specific written recommendation.
- H. Perform in situ probe test, ASTM F2170. Proceed with application only after substrates do not exceed a maximum potential equilibrium relative humidity per flooring manufacturer's formal and project specific written recommendation.
- I. Provide a written report showing test placement and results.
- J. Prepare joints in accordance with Section 07 92 00, JOINT SEALANTS and material manufacturer's instructions.
- K. Alkalinity: Measure surface pH in accordance with procedures provided in ASTM F710 or as outlined by qualified testing agency or flooring manufacturer's technical representative.
- L. Tolerances: Subsurface shall meet the flatness and levelness tolerance specified on drawings or recommended by the floor finish manufacturer. Tolerance shall also not to exceed 1/4" deviation in 10'. As required, install underlayment to achieve required tolerance.
- M. Other Subsurface: For all other subsurface conditions, such as wood or metal, contact the floor finish or underlayment manufacturer, as appropriate, for proper preparation practices.

### **3.3 MOISTURE REMEDIATION COATING:**

- A. Where results of relative humidity testing (ASTM F2170) exceed the requirements of the specified flooring manufacturer, apply remedial coating as specified to correct excessive moisture condition.
- B. Prior to remedial floor coating installation mechanically prepare the concrete surface to provide a concrete surface profile in accordance with ASTM D4259.
- C. Mix and apply moisture remediation coating in accordance with manufacturer's instructions.

### **3.4 CEMENTITIOUS UNDERLAYMENT:**

- A. Install cementitious self-leveling underlayment as required to correct surface defects, floor flatness or levelness corrections to meet the tolerance requirements as or detailed on drawings, address non-moving cracks or joints, provide a smooth surface for the installation of floor covering, or meet elevation requirements detailed on drawings.
- B. Mix and apply in accordance with manufacturer's instructions.

### **3.5 PROTECTION**

- A. Prior to the installation of the finish flooring, the surface of the underlayment should be protected from abuse by other trades by the use of plywood, tempered hardwood, or other suitable protection course

### **3.6 FIELD QUALITY CONTROL**

- A. Where specified, field sampling of products shall be conducted by a qualified, independent testing facility.

--- E N D ---

**SECTION 09 22 16**  
**NON-STRUCTURAL METAL FRAMING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies steel studs wall systems, shaft wall systems, ceiling or soffit suspended or furred framing, wall furring, fasteners, and accessories for the screw attachment of gypsum board, or other building boards.

**1.2 RELATED WORK**

- A. Support for wall mounted items: Section 05 50 00, METAL FABRICATIONS.
- B. Ceiling suspension systems for acoustical tile or panels and lay in gypsum board panels: Section 09 51 00, ACOUSTICAL CEILINGS Section 09 29 00, GYPSUM BOARD.

**1.3 TERMINOLOGY**

- A. Description of terms shall be in accordance with ASTM C754, ASTM C11, ASTM C841 and as specified.
- B. Underside of Structure Overhead: In spaces where steel trusses or bar joists are shown, the underside of structure overhead shall be the underside of the floor or roof construction supported by beams, trusses, or bar joists. In interstitial spaces with walk-on floors the underside of the walk-on floor is the underside of structure overhead.
- C. Thickness of steel specified is the minimum bare (uncoated) steel thickness.

**1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
  - 1. Studs, runners and accessories.
  - 2. Hanger inserts.
  - 3. Channels (Rolled steel).
  - 4. Furring channels.
  - 5. Screws, clips and other fasteners.
- C. Shop Drawings:
  - 1. Typical ceiling suspension system.
  - 2. Typical metal stud and furring construction system including details around openings and corner details.
  - 3. Typical shaft wall assembly
  - 4. Typical fire rated assembly and column fireproofing showing details of construction same as that used in fire rating test.
- D. Test Results: Fire rating test designation, each fire rating required for each assembly.



## 1.5 DELIVERY, IDENTIFICATION, HANDLING AND STORAGE

In accordance with the requirements of ASTM C754.

## 1.6 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society For Testing And Materials (ASTM)
  - A641-09.....Zinc-Coated (Galvanized) Carbon Steel Wire
  - A653/653M-11.....Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.
  - C11-10 ..... Terminology Relating to Gypsum and Related Building Materials and Systems
  - C635-07 ..... Manufacture, Performance, and Testing of Metal Suspension System for Acoustical Tile and Lay-in Panel Ceilings
  - C636-08 ..... Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels
  - C645-09 ..... Non-Structural Steel Framing Members
  - C754-11 ..... Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products
  - C841-03(R2008) ..... Installation of Interior Lathing and Furring
  - C954-10 ..... Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness
  - E580-11.....Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Moderate Seismic Restraint.

## PART 2 - PRODUCTS

### 2.1 PROTECTIVE COATING

Galvanize steel studs, runners (track), rigid (hat section) furring channels, "Z" shaped furring channels, and resilient furring channels, with coating designation of G40 or equivalent.

### 2.2 STEEL STUDS AND RUNNERS (TRACK)

- A. ASTM C645, modified for thickness specified and sizes as shown.
  - 1. Use C 645 steel, 0.75 mm (0.0296-inch) minimum base-metal (30 mil).
  - 2. Runners same thickness as studs.
  - 3. Exception: Members that can show certified third party testing with gypsum board in accordance with ICC ES AC86 (Approved May 2012) need not meet the minimum thickness limitation or minimum section properties set forth in ASTM C 645. The submission of an

evaluation report is acceptable to show conformance to this requirement. Use C 645 steel, 0.48mm (0.019 inch) minimum base-metal (19 mil).

- B. Provide not less than two cutouts in web of each stud, approximately 300 mm (12 inches) from each end, and intermediate cutouts on approximately 600 mm (24-inch) centers.
- C. Doubled studs for openings and studs for supporting concrete backer-board.
- D. Studs 3600 mm (12 feet) or less in length shall be in one piece.

## **2.3 FURRING CHANNELS**

- A. Rigid furring channels (hat shape): ASTM C645.
- B. Resilient furring channels:
  - 1. Not less than 0.45 mm (0.0179-inch) thick bare metal.
  - 2. Semi-hat shape, only one flange for anchorage with channel web leg slotted on anchorage side, channel web leg on other side stiffens fastener surface but shall not contact anchorage surface other channel leg is attached to.
- C. "Z" Furring Channels:
  - 1. Not less than 0.45 mm (0.0179-inch)-thick metal, with 32 mm (1-1/4 inch) and 19 mm (3/4-inch) flanges.
  - 2. Web furring depth to suit thickness of insulation.
- D. Rolled Steel Channels: ASTM C754, cold rolled; or, ASTM C841, cold rolled.

## **2.4 FASTENERS, CLIPS, AND OTHER METAL ACCESSORIES**

- A. ASTM C754, except as otherwise specified.
- B. For fire rated construction: Type and size same as used in fire rating test.
- C. Fasteners for steel studs thicker than 0.84 mm (0.033-inch) thick. Use ASTM C954 steel drill screws of size and type recommended by the manufacturer of the material being fastened.
- D. Clips: ASTM C841 (paragraph 6.11), manufacturer's standard items. Clips used in lieu of tie wire shall have holding power equivalent to that provided by the tie wire for the specific application.
- E. Concrete ceiling hanger inserts (anchorage for hanger wire and hanger straps): Steel, zinc-coated (galvanized), manufacturers standard items, designed to support twice the hanger loads imposed and the type of hanger used.
- F. Tie Wire and Hanger Wire:
  - 1. ASTM A641, soft temper, Class 1 coating.
  - 2. Gage (diameter) as specified in ASTM C754 or ASTM C841.
- G. Attachments for Wall Furring:
  - 1. Manufacturers standard items fabricated from zinc-coated (galvanized) steel sheet.
  - 2. For concrete or masonry walls: Metal slots with adjustable inserts or adjustable wall furring brackets. Spacers may be fabricated from 1 mm (0.0396-inch) thick galvanized steel with corrugated edges.

- H. Power Actuated Fasteners: Type and size as recommended by the manufacturer of the material being fastened.

## **2.5 SUSPENDED CEILING SYSTEM FOR GYPSUM BOARD (OPTION)**

- A. Conform to ASTM C635, heavy duty, with not less than 35 mm (1-3/8 inch) wide knurled capped flange face designed for screw attachment of gypsum board.
- B. Wall track channel with 35 mm (1-3/8 inch) wide flange.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION CRITERIA**

- A. Where fire rated construction is required for walls, partitions, columns, beams and floor-ceiling assemblies, the construction shall be same as that used in fire rating test.
- B. Construction requirements for fire rated assemblies and materials shall be as shown and specified, the provisions of the Scope paragraph (1.2) of ASTM C754 and ASTM C841 regarding details of construction shall not apply.

### **3.2 INSTALLING STUDS**

- A. Install studs in accordance with ASTM C754, except as otherwise shown or specified.
- B. Space studs not more than 610 mm (24 inches) on center.
- C. Cut studs 6 mm to 9 mm (1/4 to 3/8-inch) less than floor to underside of structure overhead when extended to underside of structure overhead.
- D. Where studs are shown to terminate above suspended ceilings, provide bracing as shown or extend studs to underside of structure overhead.
- E. Extend studs to underside of structure overhead for fire, rated partitions, smoke partitions, shafts, and sound rated partitions and insulated exterior wall furring.
- F. Openings:
  - 1. Frame jambs of openings in stud partitions and furring with two studs placed back to back or as shown.
  - 2. Fasten back to back studs together with 9 mm (3/8-inch) long Type S pan head screws at not less than 600 mm (two feet) on center, staggered along webs.
  - 3. Studs fastened flange to flange shall have splice plates on both sides approximately 50 X 75 mm (2 by 3 inches) screwed to each stud with two screws in each stud. Locate splice plates at 600 mm (24 inches) on center between runner tracks.
- G. Fastening Studs:
  - 1. Fasten studs located adjacent to partition intersections, corners and studs at jambs of openings to flange of runner tracks with two screws through each end of each stud and flange of runner.
  - 2. Do not fasten studs to top runner track when studs extend to underside of structure overhead.
- H. Chase Wall Partitions:

1. Locate cross braces for chase wall partitions to permit the installation of pipes, conduits, carriers and similar items.
2. Use studs or runners as cross bracing not less than 63 mm (2-1/2 inches wide).
- I. Form building seismic or expansion joints with double studs back to back spaced 75 mm (three inches) apart plus the width of the seismic or expansion joint.
- J. Form control joint, with double studs spaced 13 mm (1/2-inch) apart.

### **3.3 INSTALLING WALL FURRING FOR FINISH APPLIED TO ONE SIDE ONLY**

- A. In accordance with ASTM C754, or ASTM C841 except as otherwise specified or shown.
- B. Wall furring-Stud System:
  1. Framed with 63 mm (2-1/2 inch) or narrower studs, 600 mm (24 inches) on center.
  2. Brace as specified in ASTM C754 for Wall Furring-Stud System or brace with sections or runners or studs placed horizontally at not less than three foot vertical intervals on side without finish.
  3. Securely fasten braces to each stud with two Type S pan head screws at each bearing.
- C. Direct attachment to masonry or concrete; rigid channels or "Z" channels:
  1. Install rigid (hat section) furring channels at 600 mm (24 inches) on center, horizontally or vertically.
  2. Install "Z" furring channels vertically spaced not more than 600 mm (24 inches) on center.
  3. At corners where rigid furring channels are positioned horizontally, provide mitered joints in furring channels.
  4. Ends of spliced furring channels shall be nested not less than 200 mm (8 inches).
  5. Fasten furring channels to walls with power-actuated drive pins or hardened steel concrete nails. Where channels are spliced, provide two fasteners in each flange.
  6. Locate furring channels at interior and exterior corners in accordance with wall finish material manufacturers printed erection instructions. Locate "Z" channels within 100 mm (4 inches) of corner.
- D. Installing Wall Furring-Bracket System: Space furring channels not more than 400 mm (16 inches) on center.

### **3.4 INSTALLING SUPPORTS REQUIRED BY OTHER TRADES**

- A. Provide for attachment and support of electrical outlets, plumbing, laboratory or heating fixtures, recessed type plumbing fixture accessories, access panel frames, wall bumpers, wood seats, toilet stall partitions, dressing booth partitions, urinal screens, chalkboards, tackboards, wall-hung casework, handrail brackets, recessed fire extinguisher cabinets and other items like auto door buttons and auto door operators supported by stud construction.
- B. Provide additional studs where required. Install metal backing plates, or special metal shapes as required, securely fastened to metal studs.

### 3.5 INSTALLING FURRED AND SUSPENDED CEILINGS OR SOFFITS

- A. Install furred and suspended ceilings or soffits in accordance with ASTM C754 or ASTM C841 except as otherwise specified or shown for screw attached gypsum board ceilings and for plaster ceilings or soffits.
  - 1. Space framing at 400 mm (16-inch) centers for metal lath anchorage.
  - 2. Space framing at 600 mm (24-inch) centers for gypsum board anchorage.
- B. New exposed concrete slabs:
  - 1. Use metal inserts required for attachment and support of hangers or hanger wires with tied wire loops for embedding in concrete.
  - 2. Furnish for installation under Division 3, CONCRETE.
  - 3. Suspended ceilings under concrete rib construction shall have runner channels at right angles to ribs and be supported from ribs with hangers at ends and at 1200 mm (48-inch) maximum intervals along channels. Stagger hangers at alternate channels.
- C. Concrete slabs on steel decking composite construction:
  - 1. Use pull down tabs when available.
  - 2. Use power activated fasteners when direct attachment to structural framing can not be accomplished.
- D. Where bar joists or beams are more than 1200 mm (48 inches) apart, provide intermediate hangers so that spacing between supports does not exceed 1200 mm (48 inches). Use clips, bolts, or wire ties for direct attachment to steel framing.
- E. Installing suspended ceiling system for gypsum board (ASTM C635 Option):
  - 1. Install only for ceilings to receive screw attached gypsum board.
  - 2. Install in accordance with ASTM C636.
    - a. Install main runners spaced 1200 mm (48 inches) on center.
    - b. Install 1200 mm (four foot) tees not over 600 mm (24 inches) on center; locate for edge support of gypsum board.
    - c. Install wall track channel at perimeter.
- F. Installing Ceiling Bracing System:
  - 1. Construct bracing of 38 mm (1-1/2 inch) channels for lengths up to 2400 mm (8 feet) and 50 mm (2 inch) channels for lengths over 2400 mm (8 feet) with ends bent to form surfaces for anchorage to carrying channels and over head construction. Lap channels not less than 600 mm (2 feet) at midpoint back to back. Screw or bolt lap together with two fasteners.
  - 2. Install bracing at an approximate 45 degree angle to carrying channels and structure overhead; secure as specified to structure overhead with two fasteners and to carrying channels with two fasteners or wire ties.
  - 3. Brace suspended ceiling or soffit framing in seismic areas in accordance with ASTM E580.

**3.6 TOLERANCES**

- A. Fastening surface for application of subsequent materials shall not vary more than 3 mm (1/8-inch) from the layout line.
- B. Plumb and align vertical members within 3 mm (1/8-inch.)
- C. Level or align ceilings within 3 mm (1/8-inch.)

--- E N D ---

**SECTION 09 29 00  
GYPSUM BOARD**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies installation and finishing of gypsum board.

**1.2 RELATED WORK**

- A. Installation of steel framing members for walls, partitions, furring, soffits, and ceilings: Section 09 22 16, NON-STRUCTURAL METAL FRAMING.
- B. Acoustical Sealants: Section 07 92 00, JOINT SEALANTS.

**1.3 TERMINOLOGY**

- A. Definitions and description of terms shall be in accordance with ASTM C11, C840, and as specified.
- B. Underside of Structure Overhead: In spaces where steel trusses or bar joists are shown, the underside of structure overhead shall be the underside of the floor or roof construction supported by the trusses or bar joists.
- C. "Yoked": Gypsum board cut out for opening with no joint at the opening (along door jamb or above the door).

**1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
  - 1. Cornerbead and edge trim.
  - 2. Finishing materials.
  - 3. Laminating adhesive.
  - 4. Gypsum board, each type.
- C. Shop Drawings:
  - 1. Typical gypsum board installation, showing corner details, edge trim details and the like.
  - 2. Typical sound rated assembly, showing treatment at perimeter of partitions and penetrations at gypsum board.
  - 3. Typical shaft wall assembly.
  - 4. Typical fire rated assembly and column fireproofing, indicating details of construction same as that used in fire rating test.
- D. Samples:
  - 1. Cornerbead.
  - 2. Edge trim.
  - 3. Control joints.
- E. Test Results:

1. Fire rating test, each fire rating required for each assembly.

## **1.5 DELIVERY, IDENTIFICATION, HANDLING AND STORAGE**

In accordance with the requirements of ASTM C840.

## **1.6 ENVIRONMENTAL CONDITIONS**

In accordance with the requirements of ASTM C840.

## **1.7 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing And Materials (ASTM):
  - C11-08 ..... Terminology Relating to Gypsum and Related Building Materials and Systems
  - C475-02 ..... Joint Compound and Joint Tape for Finishing Gypsum Board
  - C840-08 ..... Application and Finishing of Gypsum Board
  - C919-08 ..... Sealants in Acoustical Applications
  - C954-07 ..... Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases to Steel Stud from 0.033 in. (0.84mm) to 0.112 in. (2.84mm) in thickness
  - C1002-07 ..... Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs
  - C1047-05 ..... Accessories for Gypsum Wallboard and Gypsum Veneer Base
  - C1177-06 ..... Glass Mat Gypsum Substrate for Use as Sheathing
  - C1658-06 ..... Glass Mat Gypsum Panels
  - C1396-06 ..... Gypsum Board
  - E84-08..... Surface Burning Characteristics of Building Materials
- C. Underwriters Laboratories Inc. (UL):
  - Latest Edition ..... Fire Resistance Directory
- D. Inchcape Testing Services (ITS):
  - Latest Editions..... Certification Listings

## **PART 2 - PRODUCTS**

### **2.1 GYPSUM BOARD**

- A. Gypsum Board: ASTM C1396, Type X, 16 mm (5/8 inch) thick unless shown otherwise. Shall contain a minimum of 20 percent recycled gypsum.
- B. Coreboard or Shaft Wall Liner Panels.
  1. ASTM C1396, Type X.
  2. ASTM C1658: Glass Mat Gypsum Panels,



3. Coreboard for shaft walls 300, 400, 600 mm (12, 16, or 24 inches) wide by required lengths 25 mm (one inch) thick with paper faces treated to resist moisture.
- C. Water Resistant Gypsum Backing Board: ASTM C620, Type X, 16 mm (5/8 inch) thick.
- D. Gypsum cores shall contain a minimum of 95 percent post industrial recycled gypsum content. Paper facings shall contain 100 percent post-consumer recycled paper content.

## **2.2 ACCESSORIES**

- A. ASTM C1047, except form of 0.39 mm (0.015 inch) thick zinc coated steel sheet or rigid PVC plastic.
- B. Flanges not less than 22 mm (7/8 inch) wide with punchouts or deformations as required to provide compound bond.

## **2.3 FASTENERS**

- A. ASTM C1002 and ASTM C840, except as otherwise specified.
- B. ASTM C954, for steel studs thicker than 0.04 mm (0.33 inch).
- C. Select screws of size and type recommended by the manufacturer of the material being fastened.
- D. For fire rated construction, type and size same as used in fire rating test.
- E. Clips: Zinc-coated (galvanized) steel; gypsum board manufacturer's standard items.

## **2.4 FINISHING MATERIALS AND LAMINATING ADHESIVE**

ASTM C475 and ASTM C840. Free of antifreeze, vinyl adhesives, preservatives, biocides and other VOC. Adhesive shall contain a maximum VOC content of 50 g/l.

## **PART 3 - EXECUTION**

### **3.1 GYPSUM BOARD HEIGHTS**

- A. Extend all layers of gypsum board from floor to underside of structure overhead on following partitions and furring:
  1. Two sides of partitions:
    - a. Fire rated partitions.
    - b. Smoke partitions.
    - c. Sound rated partitions.
    - d. Full height partitions shown (FHP).
    - e. Corridor partitions.
  2. One side of partitions or furring:
    - a. Inside of exterior wall furring or stud construction.
    - b. Room side of room without suspended ceilings.
    - c. Furring for pipes and duct shafts, except where fire rated shaft wall construction is shown.
  3. Extend all layers of gypsum board construction used for fireproofing of columns from floor to underside of structure overhead, unless shown otherwise.
- B. In locations other than those specified, extend gypsum board from floor to heights as follows:

1. Not less than 100 mm (4 inches) above suspended acoustical ceilings.
2. At ceiling of suspended gypsum board ceilings.
3. At existing ceilings.

### **3.2 INSTALLING GYPSUM BOARD**

- A. Coordinate installation of gypsum board with other trades and related work.
- B. Install gypsum board in accordance with ASTM C840, except as otherwise specified.
- C. Moisture and Mold-Resistant Assemblies: Provide and install moisture and mold-resistant glass mat gypsum wallboard products with moisture-resistant surfaces complying with ASTM C1658 where shown and in locations which might be subject to moisture exposure during construction. Install at all plumbing walls and walls either finished full height or partial height with ceramic tile and ceramic cove base..
- D. Use gypsum boards in maximum practical lengths to minimize number of end joints.
- E. Bring gypsum board into contact, but do not force into place.
- F. Ceilings:
  1. For single-ply construction, use perpendicular application.
  2. For two-ply assemblies:
    - a. Use perpendicular application.
    - b. Apply face ply of gypsum board so that joints of face ply do not occur at joints of base ply with joints over framing members.
- G. Walls (Except Shaft Walls):
  1. When gypsum board is installed parallel to framing members, space fasteners 300 mm (12 inches) on center in field of the board, and 200 mm (8 inches) on center along edges.
  2. When gypsum board is installed perpendicular to framing members, space fasteners 300 mm (12 inches) on center in field and along edges.
  3. Stagger screws on abutting edges or ends.
  4. For single-ply construction, apply gypsum board with long dimension either parallel or perpendicular to framing members as required to minimize number of joints except gypsum board shall be applied vertically over "Z" furring channels.
  5. For two-ply gypsum board assemblies, apply base ply of gypsum board to assure minimum number of joints in face layer. Apply face ply of wallboard to base ply so that joints of face ply do not occur at joints of base ply with joints over framing members.
  6. For three-ply gypsum board assemblies, apply plies in same manner as for two-ply assemblies, except that heads of fasteners need only be driven flush with surface for first and second plies. Apply third ply of wallboard in same manner as second ply of two-ply assembly, except use fasteners of sufficient length enough to have the same penetration into framing members as required for two-ply assemblies.

7. No offset in exposed face of walls and partitions will be permitted because of single-ply and two-ply or three-ply application requirements.
8. Control Joints ASTM C840 and as follows:
  - a. Locate at both side jambs of openings if gypsum board is not "yoked". Use one system throughout.
  - b. Not required for wall lengths less than 9000 mm (30 feet).
  - c. Extend control joints the full height of the wall or length of soffit/ceiling membrane.
- H. Fire and Smoke Partitions:
  1. Cut gypsum board for a space approximately 3 mm to 6 mm (1/8 to 1/4 inch) wide around partition perimeter.
  2. Coordinate for application of caulking or sealants to space prior to taping and finishing.
- I. Electrical and Telecommunications Boxes:
  1. Seal annular spaces between electrical and telecommunications receptacle boxes and gypsum board partitions.
- J. Accessories:
  1. Set accessories plumb, level and true to line, neatly mitered at corners and intersections, and securely attach to supporting surfaces as specified.
  2. Install in one piece, without the limits of the longest commercially available lengths.
  3. Corner Beads:
    - a. Install at all vertical and horizontal external corners and where shown.
    - b. Use screws only. Do not use crimping tool.
  4. Edge Trim (casings Beads):
    - a. At both sides of expansion and control joints unless shown otherwise.
    - b. Where gypsum board terminates against dissimilar materials and at perimeter of openings, except where covered by flanges, casings or permanently built-in equipment.
    - c. Where gypsum board surfaces of non-load bearing assemblies abut load bearing members.
    - d. Where shown.

### **3.3 INSTALLING GYPSUM SHEATHING**

- A. Install in accordance with ASTM C840, except as otherwise specified or shown.
- B. Use screws of sufficient length to secure sheathing to framing.
- C. Space screws 9 mm (3/8 inch) from ends and edges of sheathing and 200 mm (8 inches) on center. Space screws a maximum of 200 mm (8 inches) on center on intermediate framing members.
- D. Apply 600 mm by 2400 mm (2 foot by 8 foot) sheathing boards horizontally with tongue edge up.
- E. Apply 1200 mm by 2400 mm or 2700 mm (4 ft. by 8 ft. or 9 foot) gypsum sheathing boards vertically with edges over framing.

### **3.4 NOT USED**

### **3.5 FINISHING OF GYPSUM BOARD**

- A. Finish joints, edges, corners, and fastener heads in accordance with ASTM C840. Use Level 4 finish for all finished areas open to public view.
- B. Before proceeding with installation of finishing materials, assure the following:
  - 1. Gypsum board is fastened and held close to framing or furring.
  - 2. Fastening heads in gypsum board are slightly below surface in dimple formed by driving tool.
- C. Finish joints, fasteners, and all openings, including openings around penetrations, on that part of the gypsum board extending above suspended ceilings to seal surface of non decorated smoke barrier and fire rated gypsum board construction. After the installation of hanger rods, hanger wires, supports, equipment, conduits, piping and similar work, seal remaining openings and maintain the integrity of the smoke barrier, fire rated construction Sanding is not required of non decorated surfaces.

### **3.6 REPAIRS**

- A. After taping and finishing has been completed, and before decoration, repair all damaged and defective work, including nondecorated surfaces.
- B. Patch holes or openings 13 mm (1/2 inch) or less in diameter, or equivalent size, with a setting type finishing compound or patching plaster.
- C. Repair holes or openings over 13 mm (1/2 inch) diameter, or equivalent size, with 16 mm (5/8 inch) thick gypsum board secured in such a manner as to provide solid substrate equivalent to undamaged surface.
- D. Tape and refinish scratched, abraded or damaged finish surfaces including cracks and joints in non decorated surface to provide smoke tight construction fire protection equivalent to the fire rated construction .

--- E N D ---

**SECTION 09 51 00**  
**ACOUSTICAL CEILINGS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Acoustical units.

**1.2 NOT USED**

**1.3 APPLICABLE PUBLICATIONS**

- A. Comply with references to extent specified in this section.
- B. ASTM International (ASTM):
  - 1. A641/A641M-09a(2014) - Zinc-coated (Galvanized) Carbon Steel Wire.
  - 2. A653/A653M-15e1 - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-coated (Galvannealed) by the Hot-Dip Process.
  - 3. C423-09a - Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
  - 4. C634-13 - Terminology Relating to Environmental Acoustics.
  - 5. C635/C635M-13a - Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
  - 6. C636/C636M-13 - Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
  - 7. D1779-98(2011) - Adhesive for Acoustical Materials.
  - 8. E84-15b - Surface Burning Characteristics of Building Materials.
  - 9. E119-16 - Fire Tests of Building Construction and Materials.
  - 10. E413-16 - Classification for Rating Sound Insulation.
  - 11. E580/E580M-14 - Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions.
  - 12. E1264-14 - Classification for Acoustical Ceiling Products.
- C. International Organization for Standardization (ISO):
  - 1. ISO 14644-1 - Classification of Air Cleanliness.

**1.4 PREINSTALLATION MEETINGS**

- A. Conduct preinstallation meeting at project site minimum 30 days before beginning Work of this section.
  - 1. Required Participants:
    - a. Contracting Officer's Representative.
    - b. Architect/Engineer.
    - c. Contractor.

- d. Installer.
  - e. Other installers responsible for adjacent and intersecting work, including sprinkler HVAC and lighting installers.
- 2. Meeting Agenda: Distribute agenda to participants minimum 3 days before meeting.
  - a. Installation schedule.
  - b. Installation sequence.
  - c. Preparatory work.
  - d. Protection before, during, and after installation.
  - e. Installation.
  - f. Terminations.
  - g. Transitions and connections to other work.
  - h. Inspecting and testing.
  - i. Other items affecting successful completion.
- 3. Document and distribute meeting minutes to participants to record decisions affecting installation.

## **1.5 SUBMITTALS**

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submittal Drawings:
  - 1. Show size, configuration, and fabrication and installation details.
- C. Manufacturer's Literature and Data:
  - 1. Description of each product.
  - 2. Ceiling suspension system indicating manufacturer recommendation for each application.
  - 3. Installation instructions.
  - 4. Warranty.
- D. Samples:
  - 1. Acoustical units, 150 mm (6 inches) in size, each type.
    - a. Submit quantity required to show full color and texture range.
  - 2. Suspension system, trim and molding, 300 mm (12 inches) long.
  - 3. Colored markers for access service.
  - 4. Approved samples may be incorporated into work.
- E. Sustainable Construction Submittals:
  - 1. Recycled Content: Identify post-consumer and pre-consumer recycled content percentage by weight.
  - 2. Biobased Content:
    - a. Show type and quantity for each product.
    - b. Show volatile organic compound types and quantities.
- F. Certificates: Certify each product complies with specifications.

1. Acoustical units, each type.
- G. Qualifications: Substantiate qualifications comply with specifications.
  1. Manufacturer with project experience list.
- H. Operation and Maintenance Data:
  1. Care instructions for each exposed finish product.

#### **1.6 QUALITY ASSURANCE**

- A. Manufacturer Qualifications:
  1. Regularly manufactures specified products.
  2. Manufactured specified products with satisfactory service on five similar installations for minimum five years.
    - a. Project Experience List: Provide contact names and addresses for completed projects.

#### **1.7 DELIVERY**

- A. Deliver products in manufacturer's original sealed packaging.
- B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, color, production run number, and manufacture date.
- C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

#### **1.8 STORAGE AND HANDLING**

- A. Store products indoors in dry, weathertight conditioned facility.
- B. Protect products from damage during handling and construction operations.

#### **1.9 FIELD CONDITIONS**

- A. Environment:
  1. Product Temperature: Minimum 21 degrees C (70 degrees F) for minimum 48 hours before installation.
  2. Work Area Ambient Conditions: HVAC systems are complete, operational, and maintaining facility design operating conditions continuously, beginning 48 hours before installation until Government occupancy.
  3. Install products when building is permanently enclosed and when wet construction is completed, dried, and cured.

#### **1.10 WARRANTY**

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

### **PART 2 - PRODUCTS**

#### **2.1 SYSTEM DESCRIPTION**

- A. Ceiling System: Acoustical ceilings units on exposed grid suspension systems.

## **2.2 SYSTEM PERFORMANCE**

- A. Design product complying with specified performance:
  - 1. Maximum Deflection: 1/360 of span, maximum.
- B. Fire Resistance: ASTM E119; as component of 1 floor-ceiling roof-ceiling assembly.
- C. Surface Burning Characteristics: When tested according to ASTM E84.
  - 1. Flame Spread Rating: 25 maximum.
  - 2. Smoke Developed Rating: 450 maximum.

## **2.3 PRODUCTS - GENERAL**

- A. Provide acoustical units from one manufacturer.
  - 1. Provide each product exposed to view from one production run.
- B. Provide suspension system from same manufacturer.
- C. Sustainable Construction Requirements:
  - 1. Mineral Base Recycled Content: 65 percent, total recycled content, minimum. Select products with recycled content to achieve overall Project recycled content requirement.
  - 2. Steel Recycled Content: 30 percent total recycled content, minimum.
  - 3. Biobased Content: 37 percent by weight biobased material, minimum.
  - 4. Low Pollutant-Emitting Materials: Comply with VOC limits specified in Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for the following products:
    - a. Non-flooring adhesives and sealants.

## **2.4 ACOUSTICAL UNITS**

- A. ACOUSTICAL TILE UNITS (AT-1):
  - 1. Ceiling Panel and Tile: ASTM E1264, bio-based content according to USDA Bio-Preferred Product requirements.
    - a. Mineral Fiber: 3.6 kg/sq. m (3/4 psf) weight, minimum.
  - 2. Classification: Provide type and form as follows:
    - a. Type IV Units - Mineral base with membrane-faced overlay, Form 2 - Water felted, minimum 16 mm (5/8 inch) thick. Apply poly (vinyl) chloride over paint coat.
    - b. NRC (Noise Reduction Coefficient): ASTM C423, minimum 0.75.
    - c. CAC (Ceiling Attenuation Class): ASTM E413, 35.
    - d. LR (Light Reflectance): Minimum 0.90.
  - 3. Lay-in panels: Sizes as indicated on Drawings, with square edges and reveal edges, where indicated.

## **2.5 METAL SUSPENSION SYSTEM**

- A. General: ASTM C635, heavy-duty system, except as otherwise specified.
  - 1. Suspension System: Provide the following:
    - a. Galvanized cold-rolled steel, bonderized.



2. Main and Cross Runner: Use same construction Do not use lighter-duty sections for cross runners.
- B. Exposed Grid Suspension System: Support of lay-in panels.
  1. Grid Width: 22 mm (7/8 inch) minimum with 8 mm (5/16 inch) minimum panel bearing surface.
  2. Molding: Fabricate from the same material with same exposed width and finish.
  3. Finish: Baked-on enamel flat texture finish.
    - a. Color: To match adjacent acoustical units.
- C. Carrying Channels Secondary Framing: Cold-rolled or hot-rolled steel, black asphaltic paint finish, rust free.
  1. Weight per 300 m (per thousand linear feet), minimum:

Size		Cold-rolled		Hot-rolled	
mm	inches	kg	pound	kg	pound
38	1-1/2	215.4	475	508	1120
50	2	267.6	590	571.5	1260

- D. Anchors and Inserts: Provide anchors or inserts to support twice the loads imposed by hangers.
  1. Hanger Inserts: Steel, zinc-coated (galvanized after fabrication).
    - a. Nailing type option for wood forms:
      - 1) Upper portion designed for anchorage in concrete and positioning lower portion below surface of concrete approximately 25 mm (one inch).
      - 2) Lower portion provided with minimum 8 mm (5/16 inch) hole to permit attachment of hangers.
    - b. Flush ceiling insert type:
      - 1) Designed to provide a shell covered opening over a wire loop to permit attachment of hangers and keep concrete out of insert recess.
      - 2) Insert opening inside shell approximately 16 mm (5/8 inch) wide by 9 mm (3/8 inch) high over top of wire.
      - 3) Wire 5 mm (3/16 inch) diameter with length to provide positive hooked anchorage in concrete.
- E. Clips: Galvanized steel, designed to secure framing member in place.
- F. Tile Splines: ASTM C635.
- G. Wire: ASTM A641.
  1. Size:
    - a. Wire Hangers: Minimum diameter 2.68 mm (0.1055 inch).
    - b. Bracing Wires: Minimum diameter 3.43 mm (0.1350 inch).

## 2.6 ACCESSORIES

- A. Adhesives: Low pollutant-emitting, water based type recommended by adhered product manufacturer for each application.
- B. Perimeter Seal: Vinyl, polyethylene or polyurethane open cell sponge material, density of 1.3 plus or minus 10 percent, compression set less than 10 percent with pressure sensitive adhesive coating on one side.
  - 1. Thickness: As required to fill voids between back of wall molding and finish wall.
  - 2. Size: Minimum 9 mm (3/8 inch) wide strip.
- C. Access Identification Markers: Colored markers with pressure sensitive adhesive on one side, paper or plastic, 6 to 9 mm (1/4 to 3/8 inch) diameter.
  - 1. Color Code: Provide the following color markers for service identification:

Color	Service
Red	Sprinkler System: Valves and Controls
Green	Domestic Water: Valves and Controls
Yellow	Chilled Water and Heating Water
Orange	Ductwork: Fire Dampers
Blue	Ductwork: Dampers and Controls
Black	Gas: Laboratory, Medical, Air and Vacuum

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Examine and verify substrate suitability for product installation.
- B. Protect existing construction and completed work from damage.
- C. Remove existing acoustical panels and suspension system to permit new installation.
  - 1. Retain existing acoustical panels suspension system for reuse where indicated.
  - 2. Dispose of removed materials.

### 3.2 INSTALLATION - GENERAL

- A. Install products according to manufacturer's instructions and approved submittal drawings.
  - 1. When manufacturer's instructions deviate from specifications, submit proposed resolution for Contracting Officer's Representative consideration.

### 3.3 ACOUSTICAL UNIT INSTALLATION

- A. Applications:
  - 1. Cut acoustic units for perimeter borders and penetrations to fit tight against penetration for joint not concealed by molding.
- B. Layout acoustical unit symmetrically, with minimum number of joints.
- C. Installation:

1. Install acoustic tiles after wet finishes have been installed and solvents have cured.
2. Install lay-in acoustic panels in exposed grid with minimum 6 mm (1/4 inch) bearing at edges on supports.
  - a. Install tile to lay level and in full contact with exposed grid.
  - b. Replace cracked, broken, stained, dirty, or tile.
3. Markers:
  - a. Install color coded markers to identify the various concealed piping, mechanical, and plumbing systems.
  - b. Attach colored markers to exposed grid on opposite sides of the units providing access.
  - c. Attach marker on exposed ceiling surface of upward access acoustical unit.
- D. Touch up damaged factory finishes.
  1. Repair painted surfaces with touch up primer.

### **3.4 CEILING SUSPENSION SYSTEM INSTALLATION**

- A. General: Install according to ASTM C636.
  1. Use direct or indirect hung suspension system or combination of both.
  2. Support a maximum area of 1.48 sq. m (16 sq. ft.) of ceiling per hanger.
  3. Prevent deflection in excess of 1/360 of span of cross runner and main runner.
  4. Provide additional hangers located at each corner of support components.
  5. Provide minimum 100 mm (4 inch) clearance from the exposed face of the acoustical units to the underside of ducts, pipe, conduit, secondary suspension channels, concrete beams or joists; and steel beam or bar joist unless furred system is shown.
  6. Provide main runners minimum 1200 mm (48 inches) in length.
  7. Install hanger wires vertically. Angled wires are not acceptable except for seismic restraint bracing wires.
- B. Direct Hung Suspension System: ASTM C635.
  1. Support main runners by hanger wires attached directly to the structure overhead.
  2. Maximum spacing of hangers, 1200 mm (4 feet) on centers unless interference occurs by mechanical systems. Use indirect hung suspension system where not possible to maintain hanger spacing.
- C. Anchorage to Structure:
  1. Concrete:
    - a. Install hanger inserts and wire loops required for support of hanger wire. Install hanger wires with looped ends through steel deck when steel deck does not have attachment device.
    - b. Use eye pins or threaded studs with screw-on eyes in existing or already placed concrete structures to support hanger wire. Install in sides of concrete beams or joists at mid height.

2. Steel:
  - a. Install carrying channels for attachment of hanger wires.
    - 1) Size and space carrying channels to support load within performance limit.
    - 2) Attach hangers to steel carrying channels, spaced four feet on center, unless area supported or deflection exceeds the amount specified.
  - b. Attach carrying channels to the bottom flange of steel beams spaced not 1200 mm (4 feet) on center before fireproofing is installed. Weld or use steel clips for beam attachment.
  - c. Attach hangers to bottom chord of bar joists or to carrying channels installed between the bar joists when hanger spacing prevents anchorage to joist. Rest carrying channels on top of the bottom chord of the bar joists, and securely wire tie or clip to joist.
- D. Indirect Hung Suspension System: ASTM C635.
  1. Space carrying channels for indirect hung suspension system maximum 1200 mm (4 feet) on center. Space hangers for carrying channels maximum 2400 mm (8 feet) on center or for carrying channels less than 1200 mm (4 feet) on center so as to insure that specified requirements are not exceeded.
  2. Support main runners by specially designed clips attached to carrying channels.

### **3.5 CEILING TREATMENT**

- A. Moldings:
  1. Install metal wall molding at perimeter of room, column, or edge at vertical surfaces.
  2. Install special shaped molding at changes in ceiling heights and at other breaks in ceiling construction to support acoustical units and to conceal their edges.
- B. Perimeter Seal:
  1. Install perimeter seal between vertical leg of wall molding and finish wall, partition, and other vertical surfaces.
  2. Install perimeter seal to finish flush with exposed faces of horizontal legs of wall molding.
- C. Existing ceiling:
  1. Where extension of existing ceilings occurs, match existing.
  2. Where acoustical units are salvaged and reinstalled or joined, use salvaged units within a space. Do not mix new and salvaged units within a space which results in contrast between old and new acoustic units.
  3. Comply with specifications for new acoustical units for new units required to match appearance of existing units.

### **3.6 CLEANING**

- A. Remove excess adhesive before adhesive sets.
- B. Clean exposed surfaces. Remove contaminants and stains.     - - - E N D - - -

**SECTION 09 65 13**  
**RESILIENT BASE AND ACCESSORIES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Resilient base (RB) adhered to interior walls and partitions.

**1.2 NOT USED**

**1.3 APPLICABLE PUBLICATIONS**

- A. Comply with references to extent specified in this section.
- B. ASTM International (ASTM):
  - 1. F1861-08(2012)e1 - Resilient Wall Base.

**1.4 SUBMITTALS**

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
  - 1. Description of each product.
  - 2. Adhesives and primers indicating manufacturer's recommendation for each application.
  - 3. Installation instructions.
- C. Samples:
  - 1. Resilient Base: 150 mm (6 inches) long, each type and color.
- D. Operation and Maintenance Data:
  - 1. Care instructions for each exposed finish product.

**1.5 DELIVERY**

- A. Deliver products in manufacturer's original sealed packaging.
- B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, color, production run number, and manufacture date.
- C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

**1.6 STORAGE AND HANDLING**

- A. Store products indoors in dry, weathertight facility.
- B. Protect products from damage when handling and during construction operations.

**1.7 FIELD CONDITIONS**

- A. Environment:
  - 1. Product Temperature: Minimum 21 degrees C (70 degrees F) for minimum 48 hours before installation.
  - 2. Work Area Ambient Temperature Range: 21 to 27 degrees C (70 to 80 degrees F) continuously, beginning 48 hours before installation.

3. Install products when building is permanently enclosed and when wet construction is completed, dried, and cured.

## **1.8 WARRANTY**

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

## **PART 2 - PRODUCTS**

### **2.1 PRODUCTS**

- A. Basis of Design: See Finish Legend.
- B. Provide each product from one manufacturer and from one production run.
- C. Sustainable Construction Requirements:
  1. Low Pollutant-Emitting Materials: Comply with VOC limits specified in Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for the following products:
    - a. Flooring Adhesives and Sealants.

### **2.2 RESILIENT BASE**

- A. Resilient Base: 3 mm (1/8 inch) thick, 150 mm (6 inches) high.
  1. Type: Rubber or vinyl; use one type throughout.
  2. ASTM F1861, Type TP thermoplastic rubber or Type TV thermoplastic vinyl, Group 2 - layered.
- B. Applications:
  1. All Locations: Style B - Cove.

### **2.3 ADHESIVES**

- A. Adhesives: Low pollutant-emitting, water based type recommended by adhered product manufacturer for each application.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Examine and verify substrate suitability for product installation.
- B. Protect existing construction and completed work from damage.
- C. Remove existing base to permit new installation.
  1. Dispose of removed materials.
- D. Correct substrate deficiencies.
  1. Fill cracks, pits, and depressions with leveling compound.
  2. Remove protrusions; grind high spots.
  3. Apply leveling compound to achieve 3 mm (1/8 inch) in 3 m (10 feet) maximum surface variation.

- E. Clean substrates. Remove contaminants capable of affecting subsequently installed product's performance.
  - 1. Mechanically clean concrete floor substrate according to ASTM D4259.
  - 2. Surface Profile: ICRI Guideline No. 310.2R.
- F. Allow substrate to dry and cure.
- G. Perform flooring manufacturer's recommended bond, substrate moisture content, and pH tests.

### **3.2 INSTALLATION GENERAL**

- A. Install products according to manufacturer's instructions.
  - 1. When instructions deviate from specifications, submit proposed resolution for Contracting Officer consideration.

### **3.3 RESILIENT BASE INSTALLATION**

- A. Applications:
  - 1. Install resilient base in rooms scheduled on Drawings.
  - 2. Install resilient base on casework and locker toe spaces, and other curb supported fixed equipment.
  - 3. Extend resilient base into closets, alcoves, and cabinet knee spaces, and around columns within scheduled room.
- B. Lay out resilient base with minimum number of joints.
  - 1. Length: 600 mm (24 inches) minimum, each piece.
  - 2. Locate joints 150 mm (6 inches) minimum from corners and intersection of adjacent materials.
- C. Installation:
  - 1. Apply adhesive uniformly for full contact between resilient base and substrate.
  - 2. Set resilient base with hairline butted joints aligned along top edge.
- D. Field form corners and end stops.
  - 1. V-groove back of outside corner.
  - 2. V-groove face of inside corner and notch cove for miter joint.
- E. Roll resilient base ensuring complete adhesion.

### **3.4 CLEANING**

- A. Remove excess adhesive before adhesive sets.
- B. Clean exposed resilient base. Remove contaminants and stains.
  - 1. Clean with mild detergent. Leave surfaces free of detergent residue.
- C. Polish exposed resilient base to gloss sheen.

### **3.5 PROTECTION**

- A. Protect products from construction traffic and operations.
  - 1. Maintain protection until directed by Contracting Officer's Representative.

- B. Replace damaged products and re-clean.
  - 1. Damaged Products include cut, gouged, scraped, torn, and unbonded products.

-- E N D --



**SECTION 09 65 19**  
**RESILIENT TILE FLOORING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

- A. This section specifies the installation of solid vinyl tile flooring, rubber tile, and accessories required for a complete installation.

**1.2 RELATED WORK:**

- A. Resilient Base: Section 09 65 13, RESILIENT BASE AND ACCESSORIES.
- C. Subfloor Testing and Preparation: Section 09 05 16, SUBSURFACE PREPARATION FOR FLOOR FINISHES.
- D. Color, Pattern and Texture for Resilient Tile Flooring and Accessories: Finish Legend on drawings.

**1.3 SUBMITTALS:**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. NOT USED.
- C. Manufacturer's Literature and Data:
  - 1. Description of each product.
  - 2. Resilient material manufacturer's recommendations for adhesives, underlayment, primers, and polish.
  - 3. Application, installation and maintenance instructions.
- D. Samples:
  - 1. Tile: Each type, color, thickness and finish.
  - 2. Edge Strips: Each type, color, thickness and finish.
- E. Shop Drawings:
  - 1. Layout of patterns as shown on the construction documents.
  - 2. Edge strip locations showing types and detail cross sections.
- F. Test Reports:
  - 1. Abrasion resistance: Depth of wear for each tile type and color and volume loss of tile, certified by independent laboratory. Tested per ASTM F510/F510M.
  - 2. Moisture and pH test results as per Section 09 05 16, SUBSURFACE PREPARATION FOR FLOOR FINISHES.

**1.4 DELIVERY:**

- A. Deliver materials to the site in original sealed packages or containers, clearly marked with the manufacturer's name or brand, type and color, production run number and date of manufacture.
- B. Materials from containers which have been distorted, damaged or opened prior to installation are not acceptable.

**1.5 STORAGE:**

- A. Store materials in a clean, dry, enclosed space off the ground, protected from harmful weather conditions and at temperature and humidity conditions recommended by the manufacturer. Protect adhesives from freezing. Store flooring, adhesives, and accessories in the spaces where they will be installed for at least 48 hours before beginning installation.

**1.6 QUALITY ASSURANCE:**

- A. Installer Qualifications: A company specializing in installation with minimum three (3) years' experience and employs experienced flooring installers who have retained, and currently hold, an INSTALL Certification, or a certification from a comparable certification program.
1. Installers to be certified by INSTALL or a comparable certification program with the following minimum criteria:
- a. US Department of Labor approved four (4) year apprenticeship program, 160 hours a year.
  - b. Career long training.
  - c. Manufacturer endorsed training.
  - d. Fundamental journeyman skills certification.
- B. Furnish product type materials from the same production run.

**1.7 WARRANTY:**

- A. Construction Warranty: Comply with FAR clause 52.246-21, "Warranty of Construction".

**1.8 APPLICABLE PUBLICATIONS:**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. ASTM International (ASTM):
- |                       |   |
|-----------------------|---|
| D2047-11 .....        | Test Method for Static Coefficient of Friction of Polish-Coated<br>Flooring Surfaces as Measured by the James Machine |
| D2240-05(R2010) ..... | Test Method for Rubber Property—Durometer Hardness  |
| D4078-02(R2008) ..... | Water Emulsion Floor Finish   |
| E648-14c .....        | Critical Radiant Flux of Floor Covering Systems Using a Radiant<br>Energy Source                                      |
| E662-14 .....         | Specific Optical Density of Smoke Generated by Solid Materials  |
| E1155/E1155M-14 ..... | Determining Floor Flatness and Floor Levelness Numbers  |
| F510/F510M-14 .....   | Resistance to Abrasion of Resilient Floor Coverings Using an<br>Abrader with a Grit Feed Method                       |
| F710-11 .....         | Preparing Concrete Floors to Receive Resilient Flooring   |
| F925-13 .....         | Test Method for Resistance to Chemicals of Resilient Flooring   |
| F1066-04(R2014) ..... | Vinyl Composition Floor Tile  |
| F1344-12(R2013) ..... | Rubber Floor Tile   |
| F1700-13a .....       | Solid Vinyl Floor Tile  |

F1869-11 ..... Test Method for Measuring Moisture Vapor Emission Rate of  
Concrete Subfloor Using Anhydrous Calcium Chloride

F2170-11 ..... Test Method for Determining Relative Humidity in Concrete Floor  
Slabs Using in Situ Probes

F2195-13 ..... Linoleum Floor Tile

C. Code of Federal Regulation (CFR):

40 CFR 59 ..... Determination of Volatile Matter Content, Water Content, Density  
Volume Solids, and Weight Solids of Surface Coating

D. International Standards and Training Alliance (INSTALL):

**PART 2 - PRODUCTS**

**2.1 PERFORMANCE REQUIREMENTS:**

- A. Provide adhesives, underlayment, primers, and polish recommended by resilient floor material manufacturer.
- B. Critical Radiant Flux: 0.45 watts per sq. cm or more, Class I, per ASTM E648.
- C. Smoke Density: Less than 450 per ASTM E662.
- D. Slip Resistance – Not less than 0.5 when tested with ASTM D2047.

**2.2 RUBBER TILE:**

- A. Tile Standard: ASTM F1344, Class I-B, homogeneous rubber tile, through mottled.
- B. Hardness: Not less than 85 as required by ASTM F1344 Manufacturer's standard hardness, measured using Shore, Type A durometer per ASTM D2240.
- C. Wearing Surface: Molded pattern.
  - 1. Molded-Pattern Figure: Landscape design.
- D. Thickness: 3.5 mm (0.125 inch).
- E. Size: 1002 x 501 mm (39.45 x 19.68 inches).

**2.3 SOLID VINYL-TILE:**

- A. Tile Standard: ASTM F1066.
  - 1. Class: Class II, through pattern homogeneous vinyl tile.
  - 2. Type: A, smooth surface.
- B. Thickness: 3.0 mm (0.120 inch).
- C. Size: 457 x 457 mm (18 x 18 inches).

**2.4 ADHESIVES:**

- A. Provide water resistant type adhesive for flooring, base and accessories as recommended by the manufacturer to suit substrate conditions. VOC content to be less than the 50 grams/L when calculated according to 40 CFR 59 (EPA Method 24). Submit manufacturer's descriptive data, documentation stating physical characteristics, and mildew and germicidal characteristics.

**2.5 PRIMER FOR CONCRETE SUBFLOORS:**

- A. Provide in accordance with Section 09 05 16, SUBSURFACE PREPARATION FOR FLOOR FINISHES.

**2.6 LEVELING COMPOUND FOR CONCRETE FLOORS:**

- A. Provide cementitious products with latex or polyvinyl acetate resins in the mix in accordance with Section 09 05 16, SUBSURFACE PREPARATION FOR FLOOR FINISHES.

**2.7 POLISH AND CLEANERS:**

- A. Cleaners: As recommended in writing by floor tile manufacturer.
- B. Polish: ASTM D4078.

**PART 3 - EXECUTION**

**3.1 ENVIRONMENTAL REQUIREMENTS:**

- A. Maintain flooring materials and areas to receive resilient flooring at a temperature above 20 degrees C (68 degrees F) for three (3) days before application, during application and two (2) days after application, unless otherwise directly by the flooring manufacturer for the flooring being installed. Maintain a minimum temperature of 13 degrees C (55 degrees F) thereafter. Provide adequate ventilation to remove moisture from area and to comply with regulations limiting concentrations of hazardous vapors.
- B. Do not install flooring until building is permanently enclosed and wet construction in or near areas to receive tile materials is complete, dry and cured.

**3.2 SUBFLOOR TESTING AND PREPARATION:**

- A. Prepare and test surfaces to receive resilient tile and adhesive as per Section 09 05 16, SUBSURFACE PREPARATION FOR FLOOR FINISHES.
  - 1. Remove existing resilient floor and existing adhesive.
- B. Prepare concrete substrates in accordance with ASTM F710.

**3.3 INSTALLATION:**

- A. Install in accordance with manufacturer's instructions for application and installation unless specified otherwise.
- B. Mix tile from at least two containers. An apparent line either of shades or pattern variance is not acceptable.
- C. Tile Layout:
  - 1. If layout is not shown on construction documents, lay tile symmetrically about center of room or space with joints aligned.
  - 2. Vary edge width as necessary to maintain full size tiles in the field, no edge tile to be less than 1/2 the field tile size, except where irregular shaped rooms make it impossible.
  - 3. Place tile pattern in the same direction; do not alternate tiles unless specifically indicated in the construction documents to the contrary.
- D. Application:

1. Adhere floor tile to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
  2. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
  3. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
  4. Roll tile floor with a minimum 45 kg (100 pound) roller.
- E. Seal joints at pipes with sealants in accordance with Section 07 92 00, JOINT SEALANTS.
- F. Installation of Edge Strips:
1. Locate edge strips under center line of doors unless otherwise shown on construction documents.
  2. Set resilient edge strips in adhesive. Anchor metal edge strips with anchors and screws.
  3. Where tile edge is exposed, butt edge strip to touch along tile edge.
  4. Where thin set ceramic tile abuts resilient tile, set edge strip against floor file and against the ceramic tile edge.

### **3.4 CLEANING AND PROTECTION:**

- A. Clean adhesive marks on exposed surfaces during the application of resilient materials before the adhesive sets. Exposed adhesive is not acceptable.
- B. Keep traffic off resilient material for a minimum 72 hours after installation.
- C. Clean flooring as recommended in accordance with manufacturer's printed maintenance instructions and within the recommended time frame. As required by the manufacturer, apply the recommended number of coats and type of polish and/or finish in accordance with manufacturer's written instructions.
- D. When construction traffic occurs over tile, cover resilient materials with reinforced kraft paper properly secured and maintained until removal is directed by COR. At entrances and where wheeled vehicles or carts are used, cover tile with plywood, hardboard, or particle board over paper, secured and maintained until removal is directed by COR.
- E. When protective materials are removed and immediately prior to acceptance, replace damaged tile and mouldings, re-clean resilient materials.

### **3.5 LOCATION:**

- A. Unless otherwise indicated in construction documents, install tile flooring, under areas where casework, laboratory and pharmacy furniture and other equipment occur.
- B. Extend tile flooring for room into adjacent closets and alcoves.

--- E N D ---

**SECTION 09 91 00  
PAINTING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

- A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the painting and finishing as shown on the construction documents and/or specified herein, including, but not limited to, the following:
  - 1. Prime painting unprimed surfaces to be painted under this Section.
  - 2. Painting items furnished with a prime coat of paint, including touching up of or repairing of abraded, damaged or rusted prime coats applied by others.
  - 3. Painting ferrous metal (except stainless steel) exposed to view.
  - 4. Painting galvanized ferrous metals exposed to view.
  - 5. Painting gypsum drywall exposed to view.
  - 6. Painting of wood exposed to view, except items which are specified to be painted or finished under other Sections of these specifications. Back painting of all wood in contact with concrete, masonry or other moisture areas.

**1.2 RELATED WORK:**

- A. Activity Hazard Analysis: Section 01 35 26, SAFETY REQUIREMENTS.
- B. Prefinished flush doors with transparent finishes: Section 08 14 00, WOOD DOORS.

**1.3 SUBMITTALS:**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. NOT USED.
- C. Painter qualifications.
- D. Manufacturer's Literature and Data:
  - 1. Before work is started, or sample panels are prepared, submit manufacturer's literature and technical data, the current Master Painters Institute (MPI) "Approved Product List" indicating brand label, product name and product code as of the date of contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use subsequent MPI "Approved Product List", however, only one (1) list may be used for the entire contract and each coating system is to be from a single manufacturer. All coats on a particular substrate must be from a single manufacturer. No variation from the MPI "Approved Product List" where applicable is acceptable.
- E. Sample Panels:
  - 1. After painters' materials have been approved and before work is started submit sample panels showing each type of finish and color specified.
  - 2. Panels to Show Color: Composition board, 100 x 250 mm (4 x 10 inch).

3. Panel to Show Transparent Finishes: Wood of same species and grain pattern as wood approved for use, 100 x 250 mm (4 x 10 inch face) minimum, and where both flat and edge grain will be exposed, 250 mm (10 inches) long by sufficient size, 50 x 50 mm (2 x 2 inch) minimum or actual wood member to show complete finish.
  4. Attach labels to panel stating the following:
    - a. Federal Specification Number or manufacturers name and product number of paints used.
    - b. Specification code number specified in Finish Legend on drawings.
    - c. Product type and color.
    - d. Name of project.
  5. Strips showing not less than 50 mm (2 inch) wide strips of undercoats and 100 mm (4 inch) wide strip of finish coat.
- F. Sample of identity markers if used.

#### **1.4 DELIVERY AND STORAGE:**

- A. Deliver materials to site in manufacturer's sealed container marked to show following:
  1. Name of manufacturer.
  2. Product type.
  3. Batch number.
  4. Instructions for use.
  5. Safety precautions.
- B. In addition to manufacturer's label, provide a label legibly printed as following:
  1. Federal Specification Number, where applicable, and name of material.
  2. Surface upon which material is to be applied.
  3. Specify Coat Types: Prime; body; finish; etc.
- C. Maintain space for storage, and handling of painting materials and equipment in a ventilated, neat and orderly condition to prevent spontaneous combustion from occurring or igniting adjacent items.
- D. Store materials at site at least 24 hours before using, at a temperature between 7 and 30 degrees C (45 and 85 degrees F).

#### **1.5 QUALITY ASSURANCE:**

- A. Qualification of Painters: Use only qualified journeyman painters for the mixing and application of paint on exposed surfaces. Submit evidence that key personnel have successfully performed surface preparation and application of coating on a minimum of three (3) similar projects within the past three (3) years.
- B. Paint Coordination: Provide finish coats which are compatible with the prime paints used. Review other Sections of these specifications in which prime paints are to be provided to ensure compatibility of the total coatings system for the various substrates. Upon request from other subcontractors, furnish information on the characteristics of the finish materials proposed to be used, to ensure that compatible prime coats are used. Provide barrier coats over incompatible primers or

remove and re-prime as required. Notify the Contracting Officer Representative (COR) in writing of any anticipated problems using the coating systems as specified with substrates primed by others.

#### **1.6 REGULATORY REQUIREMENTS:**

- A. Paint materials are to conform to the restrictions of the local Environmental and Toxic Control jurisdiction.
  - 1. Volatile Organic Compounds (VOC) Emissions Requirements: Field-applied paints and coatings that are inside the waterproofing system to not exceed limits of authorities having jurisdiction.
  - 2. Lead-Base Paint:
    - a. Comply with Section 410 of the Lead-Based Paint Poisoning Prevention Act, as amended, and with implementing regulations promulgated by Secretary of Housing and Urban Development.
    - b. Regulations concerning prohibition against use of lead-based paint in federal and federally assisted construction, or rehabilitation of residential structures are set forth in Subpart F, Title 24, Code of Federal Regulations, Department of Housing and Urban Development.
    - c. Do not use coatings having a lead content over 0.06 percent by weight of non-volatile content.
  - 3. Asbestos: Provide materials that do not contain asbestos.
  - 4. Chromate, Cadmium, Mercury, and Silica: Provide materials that do not contain zinc-chromate, strontium-chromate, Cadmium, mercury or mercury compounds or free crystalline silica.
  - 5. Human Carcinogens: Provide materials that do not contain any of the ACGIH-BKLT and ACGHI-DOC confirmed or suspected human carcinogens.
  - 6. Use high performance acrylic paints in place of alkyd paints.

#### **1.7 SAFETY AND HEALTH**

- A. Apply paint materials using safety methods and equipment in accordance with the following:
  - 1. Comply with applicable Federal, State, and local laws and regulations, and with the ACCIDENT PREVENTION PLAN, including the Activity Hazard Analysis (AHA) as specified in Section 01 35 26, SAFETY REQUIREMENTS. The AHA is to include analyses of the potential impact of painting operations on painting personnel and on others involved in and adjacent to the work zone.
- B. Safety Methods Used During Paint Application: Comply with the requirements of SSPC PA Guide 10.
- C. Toxic Materials: To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:
  - 1. The applicable manufacturer's Material Safety Data Sheets (MSDS) or local regulation.
  - 2. 29 CFR 1910.1000.
  - 3. ACGIH-BKLT and ACGHI-DOC, threshold limit values.



### 1.8 APPLICABLE PUBLICATIONS:

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.
- B. American Conference of Governmental Industrial Hygienists (ACGIH):
  - ACGIH TLV-BKLT-2012..... Threshold Limit Values (TLV) for Chemical Substances and Physical Agents and Biological Exposure Indices (BEIs)
  - ACGIH TLV-DOC-2012..... Documentation of Threshold Limit Values and Biological Exposure Indices, (Seventh Edition)
- C. ASME International (ASME):
  - A13.1-07(R2013)..... Scheme for the Identification of Piping Systems
- D. Code of Federal Regulation (CFR):
  - 40 CFR 59..... Determination of Volatile Matter Content, Water Content, Density Volume Solids, and Weight Solids of Surface Coating
- E. Commercial Item Description (CID):
  - A-A-1272A..... Plaster Gypsum (Spackling Compound)
- F. Federal Specifications (Fed Spec):
  - TT-P-1411A..... Paint, Copolymer-Resin, Cementitious (For Waterproofing Concrete and Masonry Walls) (CEP)
- G. Master Painters Institute (MPI):
  - 50 ..... Interior Latex Primer Sealer
  - 52 ..... Interior Latex, MPI Gloss Level 3
  - 79 ..... Marine Alkyd Metal Primer
  - 90 ..... Interior Wood Stain
  - 107 ..... Primer, Rust-Inhibitive, Water Based
  - 134 ..... Waterborne Galvanized Primer
  - 153 ..... Light Industrial Coating, Interior Water Based, Semi-Gloss, MPI Gloss Level 5
  - 163 ..... Exterior Water Based Semi-Gloss Light Industrial Coating, MPI Gloss Level 5
- H. Society for Protective Coatings (SSPC):
  - SSPC SP 1-82(R2004) ..... Solvent Cleaning
  - SSPC SP 2-82(R2004) ..... Hand Tool Cleaning
  - SSPC SP 3-28(R2004) ..... Power Tool Cleaning
  - SSPC SP 10/NACE No.2 ..... Near-White Blast Cleaning
  - SSPC PA Guide 10 ..... Guide to Safety and Health Requirements

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS:**

- A. Conform to the coating specifications and standards referenced in PART 3. Submit manufacturer's technical data sheets for specified coatings and solvents.

### **2.2 PAINT PROPERTIES:**

- A. Use ready-mixed (including colors), except two component epoxies, polyurethanes, polyesters, paints having metallic powders packaged separately and paints requiring specified additives.
  - B. Where no requirements are given in the referenced specifications for primers, use primers with pigment and vehicle, compatible with substrate and finish coats specified.
  - C. Provide undercoat paint produced by the same manufacturer as the finish coats. Use only thinners approved by the paint manufacturer, and use only to recommended limits.
  - D. VOC Content: For field applications that are inside the weatherproofing system, paints and coating to comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:
    - 1. Flat Paints and Coatings: 50 g/L.
    - 2. Non-flat Paints and Coatings: 150 g/L.
    - 3. Dry-Fog Coatings: 400 g/L.
    - 4. Primers, Sealers, and Undercoaters: 200 g/L.
    - 5. Anticorrosive and Antirust Paints applied to Ferrous Metals: 250 g/L.
    - 6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
    - 7. Pretreatment Wash Primers: 420 g/L.
    - 8. Shellacs, Clear: 730 g/L.
    - 9. Shellacs, Pigmented: 550 g/L.
  - E. VOC test method for paints and coatings is to be in accordance with 40 CFR 59 (EPA Method 24). Part 60, Appendix A with the exempt compounds' content determined by Method 303 (Determination of Exempt Compounds) in the South Coast Air Quality Management District's (SCAQMD) "Laboratory Methods of Analysis for Enforcement Samples" manual.
- 1.4 Biobased Content
- A. Paint products shall comply with following bio-based standards for biobased materials:

Material Type	Percent by Weight
Interior Paint	20 percent biobased material
Interior Paint- Oil Based and Solvent Alkyd	67 percent biobased material
Exterior Paint	20 percent biobased material
Wood & Concrete Stain	39 percent biobased content
Polyurethane Coatings	25 percent biobased content
Water Tank Coatings	59 percent biobased content
Wood & Concrete Sealer- Membrane Concrete Sealers	11 percent biobased content
Wood & Concrete Sealer- Penetrating Liquid	79 percent biobased content

B. The minimum-content standards are based on the weight (not the volume) of the material.

### PART 3 - EXECUTION

#### 3.1 JOB CONDITIONS:

- A. Safety: Observe required safety regulations and manufacturer's warning and instructions for storage, handling and application of painting materials.
  - 1. Take necessary precautions to protect personnel and property from hazards due to falls, injuries, toxic fumes, fire, explosion, or other harm.
  - 2. Deposit soiled cleaning rags and waste materials in metal containers approved for that purpose. Dispose of such items off the site at end of each day's work.
- B. Atmospheric and Surface Conditions:
  - 1. Do not apply coating when air or substrate conditions are:
    - a. Less than 3 degrees C (5 degrees F) above dew point.
    - b. Below 10 degrees C (50 degrees F) or over 35 degrees C (95 degrees F), unless specifically pre-approved by the COR and the product manufacturer. Under no circumstances are application conditions to exceed manufacturer recommendations.
    - c. When the relative humidity exceeds 85 percent; or to damp or wet surfaces; unless otherwise permitted by the paint manufacturer's printed instructions.
  - 2. Maintain interior temperatures until paint dries hard.
  - 3. Do no exterior painting when it is windy and dusty.
  - 4. Do not paint in direct sunlight or on surfaces that the sun will warm.
  - 5. Apply only on clean, dry and frost free surfaces except as follows:
    - a. Apply water thinned acrylic and cementitious paints to damp (not wet) surfaces only when allowed by manufacturer's printed instructions.

- b. Concrete and masonry when permitted by manufacturer's recommendations, dampen surfaces to which water thinned acrylic and cementitious paints are applied with a fine mist of water on hot dry days to prevent excessive suction and to cool surface.

### **3.2 INSPECTION:**

- A. Examine the areas and conditions where painting and finishing are to be applied and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

### **3.3 GENERAL WORKMANSHIP REQUIREMENTS:**

- A. Application may be by brush or roller. Spray application only upon acceptance from the COR in writing.
- B. Furnish to the COR a painting schedule indicating when the respective coats of paint for the various areas and surfaces will be completed. This schedule is to be kept current as the job progresses.
- C. Protect work at all times. Protect all adjacent work and materials by suitable covering or other method during progress of work. Upon completion of the work, remove all paint and varnish spots from floors, glass and other surfaces. Remove from the premises all rubbish and accumulated materials of whatever nature not caused by others and leave work in a clean condition.
- D. Remove and protect hardware, accessories, device plates, lighting fixtures, and factory finished work, and similar items, or provide in place protection. Upon completion of each space, carefully replace all removed items by workmen skilled in the trades involved.
- E. When indicated to be painted, remove electrical panel box covers and doors before painting walls. Paint separately and re-install after all paint is dry.
- F. Materials are to be applied under adequate illumination, evenly spread and flowed on smoothly to avoid runs, sags, holidays, brush marks, air bubbles and excessive roller stipple.
- G. Apply materials with a coverage to hide substrate completely. When color, stain, dirt or undercoats show through final coat of paint, the surface is to be covered by additional coats until the paint film is of uniform finish, color, appearance and coverage, at no additional cost to the Government.
- H. All coats are to be dry to manufacturer's recommendations before applying succeeding coats.

### **3.4 SURFACE PREPARATION:**

- A. General:
  - 1. The Contractor shall be held wholly responsible for the finished appearance and satisfactory completion of painting work. Properly prepare all surfaces to receive paint, which includes cleaning, sanding, and touching-up of all prime coats applied under other Sections of the work. Broom clean all spaces before painting is started. All surfaces to be painted or finished are to be completely dry, clean and smooth.
  - 2. See other sections of specifications for specified surface conditions and prime coat.
  - 3. Perform preparation and cleaning procedures in strict accordance with the paint manufacturer's instructions and as herein specified, for each particular substrate condition.

4. Clean surfaces before applying paint or surface treatments with materials and methods compatible with substrate and specified finish. Remove any residue remaining from cleaning agents used. Do not use solvents, acid, or steam on concrete and masonry. Schedule the cleaning and painting so that dust and other contaminants from the cleaning process will not fall in wet, newly painted surfaces.
5. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  - a. Concrete: 12 percent.
  - b. Fiber-Cement Board: 12 percent.
  - c. Masonry (Clay and CMU's): 12 percent.
  - d. Wood: 15 percent.
  - e. Gypsum Board: 12 percent.
  - f. Plaster: 12 percent.
- B. Wood:
  1. Sand to a smooth even surface and then dust off.
  2. Sand surfaces showing raised grain smooth between each coat.
  3. Wipe surface with a tack rag prior to applying finish.
  4. After application of prime or first coat of stain, fill cracks, nail and screw holes, depressions and similar defects with wood filler paste. Sand the surface to make smooth and finish flush with adjacent surface.
  5. Before applying finish coat, reapply wood filler paste if required, and sand surface to remove surface blemishes. Finish flush with adjacent surfaces.
  6. Fill open grained wood such as oak, walnut, ash and mahogany with MPI 91 (Wood Filler Paste), colored to match wood color.
    - a. Thin filler in accordance with manufacturer's instructions for application.
    - b. Remove excess filler, wipe as clean as possible, dry, and sand as specified.
- C. Ferrous Metals:
  1. Remove oil, grease, soil, drawing and cutting compounds, flux and other detrimental foreign matter in accordance with SSPC-SP 1 (Solvent Cleaning).
  2. Remove loose mill scale, rust, and paint, by hand or power tool cleaning, as defined in SSPC-SP 2 (Hand Tool Cleaning) and SSPC-SP 3 (Power Tool Cleaning).
  3. Fill dents, holes and similar voids and depressions in flat exposed surfaces of hollow steel doors and frames, access panels, roll-up steel doors and similar items specified to have semi-gloss or gloss finish with TT-F-322D (Filler, Two-Component Type, For Dents, Small Holes and Blow-Holes). Finish flush with adjacent surfaces.
    - a. Fill flat head countersunk screws used for permanent anchors.
    - b. Do not fill screws of item intended for removal such as glazing beads.

4. Spot prime abraded and damaged areas in shop prime coat which expose bare metal with same type of paint used for prime coat. Feather edge of spot prime to produce smooth finish coat.
  5. Spot prime abraded and damaged areas which expose bare metal of factory finished items with paint as recommended by manufacturer of item.
- D. Zinc-Coated (Galvanized) Metal, Surfaces Specified Painted:
1. Clean surfaces to remove grease, oil and other deterrents to paint adhesion in accordance with SSPC-SP 1 (Solvent Cleaning).
  2. Spot coat abraded and damaged areas of zinc-coating which expose base metal on hot-dip zinc-coated items with MPI 18 (Organic Zinc Rich Coating). Prime or spot prime with MPI 134 (Waterborne Galvanized Primer).
- E. Gypsum Plaster and Gypsum Board:
1. Remove efflorescence, loose and chalking plaster or finishing materials.
  2. Remove dust, dirt, and other deterrents to paint adhesion.
  3. Fill holes, cracks, and other depressions with CID-A-A-1272A finished flush with adjacent surface, with texture to match texture of adjacent surface. Patch holes over 25 mm (1-inch) in diameter as specified in Section for plaster or gypsum board.

### **3.5 PAINT PREPARATION:**

- A. Thoroughly mix painting materials to ensure uniformity of color, complete dispersion of pigment and uniform composition.
- B. Do not thin unless necessary for application and when finish paint is used for body and prime coats. Use materials and quantities for thinning as specified in manufacturer's printed instructions.
- C. Remove paint skins, then strain paint through commercial paint strainer to remove lumps and other particles.
- D. Mix two (2) component and two (2) part paint and those requiring additives in such a manner as to uniformly blend as specified in manufacturer's printed instructions unless specified otherwise.
- E. For tinting required to produce exact shades specified, use color pigment recommended by the paint manufacturer.

### **3.6 APPLICATION:**

- A. Start of surface preparation or painting will be construed as acceptance of the surface as satisfactory for the application of materials.
- B. Unless otherwise specified, apply paint in three (3) coats; prime, body, and finish. When two (2) coats applied to prime coat are the same, first coat applied over primer is body coat and second coat is finish coat.
- C. Apply each coat evenly and cover substrate completely.
- D. Allow not less than 48 hours between application of succeeding coats, except as allowed by manufacturer's printed instructions, and approved by COR.

- E. Apply by brush or roller. Spray application for new or existing occupied spaces only upon approval by acceptance from COR in writing.
  - 1. Apply painting materials specifically required by manufacturer to be applied by spraying.
  - 2. In new construction and in existing occupied spaces, where paint is applied by spray, mask or enclose with polyethylene, or similar air tight material with edges and seams continuously sealed including items specified in "Building and Structural Work Field Painting"; "Work not Painted"; motors, controls, telephone, and electrical equipment, fronts of sterilizes and other recessed equipment and similar prefinished items.
- F. Do not paint in closed position operable items such as access doors and panels, window sashes, overhead doors, and similar items except overhead roll-up doors and shutters.

### **3.7 PRIME PAINTING:**

- A. After surface preparation, prime surfaces before application of body and finish coats, except as otherwise specified.
- B. Spot prime and apply body coat to damaged and abraded painted surfaces before applying succeeding coats.
- C. Additional field applied prime coats over shop or factory applied prime coats are not required except for exterior exposed steel apply an additional prime coat.
- D. Prime rabbets for stop and face glazing of wood, and for face glazing of steel.
- E. Metals except boilers, incinerator stacks, and engine exhaust pipes:
  - 1. Steel and iron: MPI 79 (Marine Alkyd Metal Primer).
  - 2. Zinc-coated steel and iron: MPI 134 (Waterborne Galvanized Primer).
- F. Gypsum Board:
  - 1. Primer: MPI 50 (Interior Latex Primer Sealer).

### **3.8 EXTERIOR FINISHES:**

- A. Apply following finish coats where specified in drawings.
- B. Steel and Ferrous Metal:
  - 1. Two (2) coats of MPI 163 (Light Industrial Coating, Exterior, Water Based, Semi-Gloss, MPI Gloss Level 5)).

### **3.9 INTERIOR FINISHES:**

- A. Apply following finish coats over prime coats in spaces or on surfaces specified in drawings.
- B. Metal Work:
  - 1. Apply to exposed surfaces.
  - 2. Omit body and finish coats on surfaces concealed after installation except electrical conduit containing conductors over 600 volts.
  - 3. Ferrous Metal, Galvanized Metal, and Other Metals Scheduled:
    - a. Apply two (2) coats of MPI 47 (Interior Alkyd, Semi-Gloss) unless specified otherwise.

- b. Two (2) coats of MPI 153 (Light Industrial Coating, Interior, Water Based, Semi-Gloss, MPI Gloss Level 5).
- C. Gypsum Board:
  - 2. Two (2) coats of MPI 52 (Interior Latex, MPI Gloss Level 3).
- D. Wood:
  - 1. Sanding:
    - a. Use 220-grit sandpaper.
    - b. Sand sealers and varnish between coats.
    - c. Sand enough to scarify surface to assure good adhesion of subsequent coats, to level roughly applied sealer and varnish, and to knock off "whiskers" of any raised grain as well as dust particles.
  - 2. Transparent Finishes on Wood Except Floors.
    - a. Stain Finish:
      - 1) One (1) coat of MPI 90 (Interior Wood Stain, Semi-Transparent).
      - 2) Use wood stain of type and color required to achieve finish specified. Do not use varnish type stains.

**3.10 PAINT COLOR:**

- A. Color and gloss of finish coats is specified in Finish Legend on drawings.
- B. Coat Colors:
  - 1. Color of priming coat: Lighter than body coat.
  - 2. Color of body coat: Lighter than finish coat.
  - 3. Color prime and body coats to not show through the finish coat and to mask surface imperfections or contrasts.
- C. Painting, Caulking, Closures, and Fillers Adjacent to Casework:
  - 1. Paint to match color of casework where casework has a paint finish.
  - 2. Paint to match color of wall where casework is stainless steel, plastic laminate, or varnished wood.

**3.11 PROTECTION CLEAN UP, AND TOUCH-UP:**

- A. Protect work from paint droppings and spattering by use of masking, drop cloths, removal of items or by other approved methods.
- B. Upon completion, clean paint from hardware, glass and other surfaces and items not required to be painted of paint drops or smears.
- C. Before final inspection, touch-up or refinished in a manner to produce solid even color and finish texture, free from defects in work which was damaged or discolored.

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**SECTION 10 26 00  
WALL AND DOOR PROTECTION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

- A. This section specifies wall guards, handrail/wall guard combinations, corner guards.

**1.2 RELATED WORK:**

- A. Color and texture of aluminum and resilient material: Finish Legend in drawings.

**1.3 QUALITY ASSURANCE:**

- A. Manufacturer's Qualifications: Manufacturer with a minimum of three (3) years' experience in providing items of type specified.
  - 1. Obtain wall and door protection from single manufacturer.
- B. Installer's Qualifications: Installers are to have a minimum of three (3) years' experience in the installation of units required for this project.

**1.4 SUBMITTALS:**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. NOT USED.
- C. Shop Drawings: Show design and installation details.
- D. Manufacturer's Literature and Data:
  - 1. Handrail/Wall Guard Combinations.
  - 2. Wall Guards.
  - 3. Corner Guards.
- E. Test Report: Showing that resilient material complies with specified fire and safety code requirements.
- F. Manufacturer's qualifications.
- G. Installer's qualifications.
- H. Manufacturer's warranty.

**1.5 DELIVERY AND STORAGE:**

- A. Deliver materials to the site in original sealed packages or containers marked with the name and brand, or trademark of the manufacturer.
- B. Protect from damage from handling and construction operations before, during and after installation.
- C. Store in a dry environment of approximately 21 degrees C (70 degrees F) for at least 48 hours prior to installation.

**1.6 WARRANTY:**

- A. Construction Warranty: Comply with FAR clause 52.246-21 "Warranty of Construction".

- B. Manufacturer Warranty: Manufacturer shall warranty their wall and door protection for a minimum of five (5) years from date of installation and final acceptance by the Government. Submit manufacturer warranty.

#### 1.7 APPLICABLE PUBLICATIONS:

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. ASTM International (ASTM):
- A240/A240M-14 ..... Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and For General Applications
- B221-14..... Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
- B221M-13..... Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes (Metric)
- D256-10 ..... Impact Resistance of Plastics
- D635-10 ..... Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position
- E84-14..... Surface Burning Characteristics of Building Materials
- C. Aluminum Association (AA):
- DAF 45-09..... Designation System for Aluminum Finishes
- D. American Architectural Manufacturers Association (AAMA):
- 611-14 ..... Anodized Architectural Aluminum
- E. Code of Federal Regulation (CFR):
- 40 CFR 59..... Determination of Volatile Matter Content, Water Content, Density Volume Solids, and Weight Solids of Surface Coating
- F. The National Association of Architectural Metal Manufacturers (NAAMM):
- AMP 500-06 ..... Metal Finishes Manual
- G. National Fire Protection Association (NFPA):
- 80-13 ..... Standard for Fire Doors and Windows
- H. SAE International (SAE):
- J 1545-05(R2014) ..... Instrumental Color Difference Measurement for Exterior Finishes.
- I. Underwriters Laboratories Inc. (UL):
- Annual Issue ..... Building Materials Directory

## PART 2 - PRODUCTS

### 2.1 MATERIALS:

- A. Stainless Steel: A240/A240M, Type 304.
- B. Resilient Material:

1. Provide resilient material consisting of high impact resistant extruded acrylic vinyl, polyvinyl chloride, or injection molded thermal plastic conforming to the following:
  - a. Minimum impact resistance of 960.8 N-m/m (18 ft.-lbs./sq. inch) when tested in accordance with ASTM D256 (Izod impact, ft.-lbs. per inch notched).
  - b. Class 1 fire rating when tested in accordance with ASTM E84, having a maximum flame spread of 25 and a smoke developed rating of 450 or less.
  - c. Rated self-extinguishing when tested in accordance with ASTM D635.
  - d. Provide material labeled and tested by Underwriters Laboratories or other approved independent testing laboratory.
  - e. Provide resilient material for protection on fire rated doors and frames assemblies that is listed by the testing laboratory performing the tests.
  - f. Provide resilient material installed on fire rated wood/steel door and frame assemblies that have been tested on similar type assemblies. Test results of material tested on any other combination of door and frame assembly are not acceptable.
  - g. Provide integral color with colored components matched in accordance with SAE J 1545 to within plus or minus 1.0 on the CIE-LCH scales.

## **2.2 CORNER GUARDS:**

- A. Resilient, Shock-Absorbing Corner Guards: Surface mounted type.
  1. Snap-on corner guard formed from resilient material, minimum 1.98 mm (0.078-inch) thick, free floating on a continuous 1.52 mm (0.060-inch) thick extruded aluminum retainer. Provide appropriate mounting hardware, cushions and base plates as required.
  2. Profile: Minimum (3 inch) long leg and 6 mm (1/4 inch) corner radius.
  3. Height: Floor to ceiling.
  4. Retainer Clips: Provide manufacturer's standard impact-absorbing clips.
  5. Provide factory fabricated end closure caps at top and bottom of surface mounted corner guards.
- B. Fabricate stainless steel corner guards of 1.27 mm (.05 inch) thick material conforming to ASTM A240/A240M, Type 304. Install corner guards from floor to ceiling. Form corner guard to dimensions shown on construction documents.

## **2.3 WALL GUARDS AND HANDRAILS:**

- A. Resilient Wall Guards and Handrails:
  1. Handrail/Wall Guard Combination:
    - a. Snap-on covers of resilient material, minimum 2 mm (0.078-inch) thick.
    - b. Free-floating on a continuous, extruded aluminum retainer, minimum 1.82 mm (0.072-inch) thick.
    - c. Anchor to wall at maximum 762 mm (30 inches) on center.
  2. Wall Guards:

- a. Snap-on covers of resilient material, minimum 2.54 mm (0.100-inch) thick. Free-floating over 51 mm (2 inch) wide aluminum retainer clips, minimum 2.28 mm (0.090-inch) thick, anchored to wall at maximum 610 mm (24 inches) on center, supporting a continuous aluminum retainer, minimum 1.57 mm (0.062-inch) thick.
- 3. Provide handrails and wall guards with prefabricated end closure caps, inside and outside corners, concealed splices, cushions, mounting hardware and other accessories as required. End caps and corners to be field adjustable to assure close alignment with handrails and wall guards. Screw or bolt closure caps to aluminum retainer in a concealed manner.
- B. Stainless Steel Wall Guards: Construct wall guard, including brackets, of minimum 4.76 mm (0.1875-inch) thick stainless steel.

## **2.4 NOT USED**

## **2.5 FASTENERS AND ANCHORS:**

- A. Provide fasteners and anchors as required for each specific type of installation.
- B. Where type, size, spacing or method of fastening is not shown or specified in construction documents, submit shop drawings showing proposed installation details.

## **2.6 FINISH:**

- A. Stainless Steel: In accordance with NAAMM AMP 500 finish Number 4.
- B. Resilient Material: Embossed textures and color in accordance with SAE J1545.

## **PART 3 - INSTALLATION**

### **3.1 RESILIENT CORNER GUARDS:**

- A. Install corner guards on walls in accordance with manufacturer's instructions.

### **3.2 STAINLESS STEEL CORNER GUARDS:**

- A. Mount guards on external corners of interior walls, partitions and columns as shown on construction documents.
- B. Where corner guards are installed on gypsum board, clean surface and anchor guards with a neoprene solvent-type contact adhesive specifically manufactured for use on gypsum board construction. Remove excess adhesive from around edge of guard and allow curing undisturbed for 24 hours.

### **3.3 RESILIENT WALL GUARDS AND WALL GUARD HANDRAIL COMBINATION**

- A. Secure guards to walls with mounting cushions, brackets and fasteners in accordance with manufacturer's details and instructions.

### **3.4 STAINLESS STEEL WALL GUARDS**

- A. Space brackets at not more than 914 mm (3 feet) on centers and anchor to the wall in accordance with manufacturer's installation instructions.

### **3.5 HIGH IMPACT WALL COVERING**

- A. Surfaces to receive protection to be clean, smooth and free of obstructions.

- B. Install protectors after frames are in place but preceding installation of doors in accordance with approved shop drawings and manufacturer's specific instructions.
- C. Apply with adhesive in controlled environment according to manufacturer's recommendations.
- D. Protection installed on fire rated doors and frames to be installed according to NFPA 80 and installation procedures listed in UL Building Materials Directory; or, equal listing by other approved independent testing laboratory establishing the procedures.

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**SECTION 10 44 13**  
**FIRE EXTINGUISHER CABINETS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section covers recessed fire extinguisher cabinets.

**1.2 RELATED WORK**

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data: Fire extinguisher cabinet including installation instruction and rough opening required.

**1.4 APPLICATION PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Testing and Materials (ASTM):
  - D4802-10 ..... Poly (Methyl Methacrylate) Acrylic Plastic Sheet

**PART 2 - PRODUCTS**

**2.1 FIRE EXTINGUISHER CABINET**

Recessed type with flat trim of size and design shown.

**2.2 FABRICATION**

- A. Form body of cabinet from 0.9 mm (0.0359 inch) thick sheet steel.
- B. Fabricate door and trim from 1.2 mm (0.0478 inch) thick sheet steel with all face joints fully welded and ground smooth.
  - 1. Glaze doors with 6 mm (1/4 inch) thick ASTM D4802, clear acrylic sheet, Category B-1, Finish 1.
  - 2. Design doors to open 180 degrees.
  - 3. Provide continuous hinge, pull handle, and adjustable roller catch.

**2.3 FINISH**

- A. Finish interior of cabinet body with baked-on semigloss white enamel.
- B. Finish door, frame with manufacturer's standard baked-on prime coat suitable for field painting.

**PART 3 - EXECUTION**

- A. Install fire extinguisher cabinets in prepared openings and secure in accordance with manufacturer's instructions.
- B. Install cabinet so that bottom of cabinet is 914 mm (36 inches) above finished floor.

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**SECTION 21 13 13**  
**WET-PIPE SPRINKLER SYSTEMS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Design, installation and testing shall be in accordance with NFPA 13 except for specified exceptions.
- B. The design and installation of a hydraulically calculated automatic wet-pipe system complete and ready for operation, for all renovated portions of the new addition, including the mechanical equipment rooms, telephone rooms.
- C. Modification of the existing sprinkler system as indicated on the drawings and as further required by these specifications.

**1.2 RELATED WORK**

- A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Section 07 84 00, FIRESTOPPING. Treatment of penetrations through rated enclosures.
- C. Section 09 91 00, PAINTING.
- D. Section 28 31 00, FIRE DETECTION AND ALARM. Connection to fire alarm of flow switches, pressure switches and valve supervisory switches.

**1.3 DESIGN CRITERIA**

- A. Design Basis Information: Provide design, materials, equipment, installation, inspection, and testing of the automatic sprinkler system in accordance with the requirements of NFPA 13.
  - 1. Perform hydraulic calculations in accordance with NFPA 13 utilizing the Area/Density method. Do not restrict design area reductions permitted for using quick response sprinklers throughout by the required use of standard response sprinklers in the areas identified in this section.
  - 2. Sprinkler Protection: Sprinkler hazard classifications shall be in accordance with NFPA 13. The hazard classification examples of uses and conditions identified in the Annex of NFPA 13 shall be mandatory for areas not listed below. Request clarification from the Government for any hazard classification not identified. To determining spacing and sizing, apply the following coverage classifications:
    - a. Light Hazard Occupancies: Patient care, treatment, and customary access areas.
    - b. Ordinary Hazard Group 1 Occupancies: Laboratories, Mechanical Equipment Rooms, Transformer Rooms, Electrical Switchgear Rooms, Electric Closets, and Repair Shops.
    - c. Ordinary Hazard Group 2 Occupancies: Storage rooms, trash rooms, clean and soiled linen rooms, pharmacy and associated storage, laundry, kitchens, kitchen storage areas, retail stores, retail store storage rooms, storage areas, building management storage, boiler plants, energy centers, warehouse spaces, file storage areas for the entire area of

the space up to 140 square meters (1500 square feet) and Supply Processing and Distribution (SPD).

3. Hydraulic Calculations: Calculated demand including hose stream requirements shall fall no less than 10 percent below the available water supply curve.
4. Water Supply: Base water supply on a flow test of:
  - a. Location: Hydrant #3 near Building 31
  - b. Static pressure: 448.16 kPa (65 psi)
  - c. Residual pressure: 413.69 kPa (60 psi)
  - d. Flow: 71.80 L/s (1138 gpm)
  - e. Date: 3-8-2010

Note: The Fire Suppression Contractor shall perform a flow test on hydrants #2 and #3 in the area of the existing building to verify current available pressure and flow.

5. Zoning:
  - a. For each sprinkler zone provide a control valve, flow switch, and a test and drain assembly with pressure gauge. For buildings greater than two stories, provide a check valve at each control valve.
  - b. Sprinkler zones shall conform to the smoke barrier zones shown on the drawings.
6. Provide seismic protection in accordance with NFPA 13. Contractor shall submit load calculations for sizing of sway bracing for systems that are required to be protected against damage from earthquakes.

#### **1.4 SUBMITTALS**

- A. Submit as one package in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Prepare detailed working drawings that are signed by a NICET Level III or Level IV Sprinkler Technician or stamped by a Registered Professional Engineer licensed in the field of Fire Protection Engineering. As the Government review is for technical adequacy only, the installer remains responsible for correcting any conflicts with other trades and building construction that arise during installation. Partial submittals will not be accepted. Material submittals shall be approved prior to the purchase or delivery to the job site. Suitably bind submittals in notebooks or binders and provide an index referencing the appropriate specification section. In addition to the hard copies, provide submittal items in Paragraphs 1.4(A)1 through 1.4(A)5 electronically in pdf format on a compact disc or as directed by the COR. Submittals shall include, but not be limited to, the following:
  1. Qualifications:
    - a. Provide a copy of the installing contractors fire sprinkler and state contractor's license.
    - b. Provide a copy of the NICET certification for the NICET Level III or Level IV Sprinkler Technician who prepared and signed the detailed working drawings unless the drawings



are stamped by a Registered Professional Engineer licensed in the field of Fire Protection Engineering.

- c. Provide documentation showing that the installer has been actively and successfully engaged in the installation of commercial automatic sprinkler systems for the past ten years.
2. Drawings: Submit detailed 1:100 (1/8 inch) scale (minimum) working drawings conforming to the Plans and Calculations chapter of NFPA 13. Drawings shall include graphical scales that allow the user to determine lengths when the drawings are reduced in size. Include a plan showing the piping to the water supply test location.
3. Manufacturer's Data Sheets: Provide data sheets for all materials and equipment proposed for use on the system. Include listing information and installation instructions in data sheets. Where data sheets describe items in addition to those proposed to be used for the system, clearly identify the proposed items on the sheet.
  - a. For backflow preventers, provide flow test curves from UL, FM, or the Foundation for Hydraulic Research and Cross-Connection Control to verify pressure loss calculations.
  - b. Provide for materials and equipment proposed for use on the system. Include listing information and installation instructions in data sheets. Where data sheet describes items in addition to that item being submitted, clearly identify proposed item on the sheet.
4. Calculation Sheets:
  - a. Submit hydraulic calculation sheets in tabular form conforming to the requirements and recommendations of the Plans and Calculations chapter of NFPA 13.
  - b. Submit calculations of loads for sizing of sway bracing in accordance with NFPA 13.
5. Valve Charts: Provide a valve chart that identifies the location of each control valve. Coordinate nomenclature and identification of control valves with COR. Where existing nomenclature does not exist, the chart shall include no less than the following: Tag ID No., Valve Size, Service (control valve, main drain, aux. drain, inspectors test valve, etc.), and Location.
6. Final Document Submittals: Provide as-built drawings, testing and maintenance instructions in accordance with the requirements in Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. In addition, submittals shall include, but not be limited to, the following:
  - a. A complete set of as-built drawings showing the installed system with the specific interconnections between the system switches and the fire alarm equipment. Provide a complete set in the formats as follows. Submit items 2 and 3 below on a compact disc or as directed by the COR.
    - 1) One full size (or size as directed by the COR) printed copy.
    - 2) One complete set in electronic pdf format.

- 3) One complete set in AutoCAD format or a format as directed by the COR.
- b. Material and Testing Certificate: Upon completion of the sprinkler system installation or any partial section of the system, including testing and flushing, provide a copy of a completed Material and Testing Certificate as indicated in NFPA 13. Certificates shall be provided to document all parts of the installation.
- c. Operations and Maintenance Manuals that include step-by-step procedures required for system startup, operation, shutdown, and routine maintenance and testing. The manuals shall include the manufacturer's name, model number, parts list, and tools that should be kept in stock by the owner for routine maintenance, including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization, including address and telephone number, for each item of equipment.
- d. One paper copy of the Material and Testing Certificates and the Operations and Maintenance Manuals above shall be provided in a binder. In addition, these materials shall be provided in pdf format on a compact disc or as directed by the COR.
- e. Provide one additional copy of the Operations and Maintenance Manual covering the system in a flexible protective cover and mount in an accessible location adjacent to the riser or as directed by the COR.

#### **1.5 QUALITY ASSURANCE**

- A. Installer Reliability: The installer shall possess a valid State of Ohio fire sprinkler contractor's license. The installer shall have been actively and successfully engaged in the installation of commercial automatic sprinkler systems for the past ten years.
- B. Materials and Equipment: All equipment and devices shall be of a make and type listed by UL and approved by FM, or other nationally recognized testing laboratory for the specific purpose for which it is used. All materials, devices, and equipment shall be approved by the VA.

#### **1.6 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. National Fire Protection Association (NFPA):
  - 13-13 ..... Installation of Sprinkler Systems
  - 25-14 ..... Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems
  - 101-15 ..... Life Safety Code
  - 170-15 ..... Fire Safety Symbols
- C. Underwriters Laboratories, Inc. (UL): Fire Protection Equipment Directory (2011)
- D. Factory Mutual Engineering Corporation (FM): Approval Guide
- E. Uniform Building Code – 1997

F. Foundation for Cross-Connection Control and Hydraulic Research - 2005

## **PART 2 – PRODUCTS**

### **2.1 GENERAL**

- A. All devices and equipment shall be Underwriter Laboratories Inc. listed for their intended purpose.
- B. All sprinklers shall be UL listed and Factory Mutual approved.

### **2.2 PIPING & FITTINGS**

- A. Piping and fittings for sprinkler systems shall be in accordance with NFPA 13.
  - 1. Plain-end pipe fittings with locking lugs or shear bolts are not permitted.
  - 2. Piping sizes 50 mm (2 inches) and smaller shall be black steel Schedule 40 with threaded end connections.
  - 3. Piping sizes 65 mm (2 ½ inches) and larger shall be black steel Schedule 10 with grooved connections. Grooves in Schedule 10 piping shall be rolled grooved only.
  - 4. Plastic piping shall not be permitted except for drain piping.
- B. Piping all sizes shall be schedule 40 with threaded or flanged fittings, ANSI B1 6.3 cast iron, Class 125 minimum. Threaded fittings are not permitted on pipe with wall thickness less than schedule 40.
- C. Piping 2" size and larger sprinkler piping downstream of the system isolation valves on wet-pipe systems may be black steel, schedule 10 minimum with mechanical roll grooved fittings.
- D. Piping materials Standards:
  - 1. Ferrous piping – follow ASTM A-795 Standard
  - 2. Welded and seamless steel pipe – follow ANSI/ASTM A 53
  - 3. Wrought steel pipe – follow ANSI/ASME B36-10M
  - 4. Electrical resistance welded steel pipe – follow ASTM A 135
- E. Fitting Material Standards:
  - 1. Cast iron threaded fitting, Class 125 and 250 – follow ASME B16.4
  - 2. Cast iron pipe flanges and flanged fittings – follow ASME B16.1
  - 3. Malleable iron threaded fittings, Class 150 and 300 steel – follow ASME B16.3
  - 4. Factory made wrought steel butt weld fittings – follow ASME B16.9
  - 5. Buttwelding ends for pipe, valves, flanges and fittings – follow ASME B16.25
- F. Pipe and fittings from inside face of building 300 mm (12 in.) above finished floor to a distance of approximately 1500 mm (5 ft.) outside building: ductile iron, flanged fittings and 316 stainless steel bolting.

### **2.3 VALVES**

- A. General:
  - 1. Valves shall be in accordance with NFPA 13.
  - 2. Do not use quarter turn ball valves for 50 mm (2 inch) or larger drain valves.

- B. Control Valve: The control valves shall be a listed indicating type. Control valves shall be UL Listed or FM Approved for fire protection installations. System control valve shall be rated for normal system pressure but in no case less than 175 PSI. (No Substitutions Allowed).
- C. Check Valve: Shall be of the swing type with a flanged cast iron body and flanged inspection plate.
- D. Automatic Ball Drips: Cast brass 20 mm (3/4 inch) in-line automatic ball drip with both ends threaded with iron pipe threads.
- E. Listed indicating valves:
  - 1. Gate: OS&Y, 1200kPa (175 psig) WOG.
  - 2. Butterfly: Gear operated, indicating type, 1200 kPa (175 psig) WOG.
- F. Check Valves: Swing type, rubber faced or wafer type spring loaded butterfly check valve, 1200 kPa (175 psig) WOG.
- G. Drain Valves: Threaded bronze angle, globe, ball or butterfly, 1000 kPa (150 psig). WOG equipped with reducer and hose connection with cap or connected to a drain line.
- H. Ported alarm connections on sprinkler riser valve to be piped to a retard chamber to absorb variable pressure surges. Circuit Closer to be installed on retard chamber with proper venting capabilities to eliminate vapor or hydraulic lock against circuit closer.

## **2.4 FIRE DEPARTMENT SIAMESE CONNECTION**

- A. Brass, flush wall type, exterior fire department connection with chrome plated brass escutcheon plate, without sill cock, and a minimum of two 65 mm (2-1/2 inch) connections threaded to match those on the local fire protection service, with chrome plated caps and chains. Provide escutcheon with minimum 1" high integral raised letters "Standpipe and Automatic Sprinkler". Install an automatic ball drip between fire department connection and check valve with drain piping routed to the exterior of the building or a floor drain.

## **2.5 SPRINKLERS**

- A. All sprinklers shall be FM approved quick response. Provide FM approved quick response sprinklers in all areas, except where specifically prohibited by their listing or approval.
  - 1. Cold storage rooms: Standard response dry pendant sprinklers.  
(Note: Provide 'cages' to protect sprinkler heads from breakage/damage when the elevation of the head is less than 7 feet 6 inches above finished floor (mechanical rooms, janitor closets, etc.).
- B. Temperature Ratings: In accordance with NFPA 13.
- C. Provide sprinkler guards in accordance with NFPA 13 and when the elevation of the sprinkler head is less than 7 feet 6 inches above finished floor. The sprinkler guard shall be UL listed or FM approved for use with the corresponding sprinkler.

## **2.6 SPRINKLER CABINET**

- A. Provide the required number of sprinkler heads of all ratings and types installed, and a sprinkler wrench for each type of sprinkler in accordance with NFPA 13 in existing sprinkler cabinet.
- B. Provide a list of sprinklers installed in the property in the cabinet. The list shall include the following:
  - 1. Manufacturer, model, orifice, deflector type, thermal sensitivity, and pressure for each type of sprinkler in the cabinet.
  - 2. General description of where each sprinkler is used.
  - 3. Quantity of each type present in the cabinet.
  - 4. Issue or revision date of list.

## **2.7 SPRINKLER SYSTEM SIGNAGE**

- A. Rigid plastic, steel or aluminum signs with white lettering on a red background with holes for easy attachment. Sprinkler system signage shall be attached to the valve or piping with chain.

## **2.8 SWITCHES:**

- A. OS&Y Valve Supervisory Switches shall be in a weatherproof die cast/red baked enamel, oil resistant, aluminum housing with tamper resistant screws, 13 mm (1/2 inch) conduit entrance and necessary facilities for attachment to the valves. Provide two SPDT switches rated at 2.5 amps at 24 VDC.
- B. Water flow Alarm Switches: Mechanical, non-coded, non-accumulative retard and adjustable from 0 to 60 seconds minimum. Set flow switches at an initial setting between 20 and 30 seconds.
- C. Alarm Pressure Switches: Activation by any flow of water equal to or in excess of the discharge from one sprinkler. Water Flow Indicating Pressure Switch will activate an alarm by way of an alarm pressure switch. The alarm pressure switch shall be UL Listed or Factory Mutual Approved for the application in which it is used. Activation of the alarm pressure switch shall cause an alarm on the fire alarm system control unit. The alarm pressure switch shall have the ability to be wired for Class A or Class B service.
- D. Valve Supervisory Switches for Ball and Butterfly Valves: May be integral with the valve.

## **2.9 GAUGES**

- A. Provide gauges as required by NFPA 13. Provide gauges where the normal pressure of the system is at the midrange of the gauge.

## **2.10 PIPE HANGERS, SUPPORTS AND RESTRAINT OF SYSTEM PIPING**

- A. Supports, hangers, etc., of an approved pattern placement to conform to NFPA 13. System piping shall be substantially supported to the building structure. The installation of hangers and supports shall adhere to the requirements set forth in NFPA 13, Standard for Installation of Sprinkler Systems. Materials used in the installation or construction of hangers and supports shall be listed and approved for such application. Hangers or supports not specifically listed for service shall be designed and bear the seal of a professional engineer.

## 2.11 WALL, FLOOR AND CEILING PLATES

- A. Provide chrome plated steel escutcheon plates for exposed piping passing through walls, floors or ceilings.
- 2.12 Valve Tags
- B. Engraved black filled numbers and letters not less than 15 mm (1/2 inch) high for number designation, and not less than 8 mm (1/4 inch) for service designation on 19 gage, 40 mm (1-1/2 inches) round brass disc, attached with brass "S" hook, brass chain, or nylon twist tie.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Installation shall be accomplished by the licensed contractor. Provide a qualified technician, experienced in the installation and operation of the type of system being installed, to supervise the installation and testing of the system.
- B. Installation of Piping: Accurately cut pipe to measurements established by the installer and work into place without springing or forcing. In any situation where bending of the pipe is required, use a standard pipe-bending template. Concealed piping in spaces that have finished ceilings. Where ceiling mounted equipment exists, such as in operating and radiology rooms, install sprinklers so as not to obstruct the movement or operation of the equipment. Sidewall heads may need to be utilized. In stairways, locate piping as near to the ceiling as possible to prevent tampering by unauthorized personnel and to provide a minimum headroom clearance of 2250 mm (seven feet six inches). Piping shall not obstruct the minimum means of egress clearances required by NFPA 101. Pipe hangers, supports, and restraint of system piping, and seismic bracing shall be installed accordance with NFPA 13.
- C. Welding: Conform to the requirements and recommendations of NFPA 13.
- D. Drains: Provide drips and drains, including low point drains, in accordance with NFPA 13. Pipe drains to discharge at safe points outside of the building or to sight cones attached to drains of adequate size to readily carry the full flow from each drain under maximum pressure. Do not provide a direct drain connection to sewer system or discharge into sinks. Install drips and drains where necessary and required by NFPA 13. The drain piping shall not be restricted or reduced and shall be of the same diameter as the drain collector.
- E. Supervisory Switches: Provide supervisory switches for sprinkler control valves.
- F. Waterflow Alarm Switches: Install waterflow alarm switches and valves in stairwells or other easily accessible locations.
- G. Inspector's Test Connection: Install and supply in accordance with NFPA 13, locate in a secured area, and discharge to the exterior of the building.
- H. Affix cutout disks, which are created by cutting holes in the walls of pipe for flow switches and non-threaded pipe connections to the respective waterflow switch or pipe connection near to the pipe from where they were cut.
- I. Provide escutcheon plates for exposed piping passing through walls, floors or ceilings.

- J. Clearances: For systems requiring seismic protection, piping that passes through floors or walls shall have penetrations sized 50 mm (2 inches) nominally larger than the penetrating pipe for pipe sizes 25 mm (1 inch) to 90 mm (3 ½ inches) and 100 mm (4 inches) nominally larger for penetrating pipe sizes 100 mm (4 inches) and larger.
- K. Sleeves: Provide for pipes passing through masonry or concrete. Provide space between the pipe and the sleeve in accordance with NFPA 13. Seal this space with a UL Listed through penetration fire stop material in accordance with Section 07 84 00, FIRESTOPPING. Where core drilling is used in lieu of sleeves, also seal space. Seal penetrations of walls, floors and ceilings of other types of construction, in accordance with Section 07 84 00, FIRESTOPPING.
- L. Provide pressure gauges at each water flow alarm switch location and at each main drain connection.
- M. Firestopping shall be provided for all penetrations of fire resistance rated construction. Firestopping shall comply with Section 07 84 00, FIRESTOPPING.
- N. Painting of Pipe: In finished areas where walls and ceilings have been painted, paint primed surfaces with two coats of paint to match adjacent surfaces, except paint valves and operating accessories with two coats of gloss red enamel. Exercise care to avoid painting sprinklers. Painting of sprinkler systems above suspended ceilings and in crawl spaces is not required. Painting shall comply with Section 09 91 00, PAINTING. Any painted sprinkler shall be replaced with a new sprinkler.
- O. Sprinkler System Signage: Provide rigid sprinkler system signage in accordance with NFPA 13 and NFPA 25. Sprinkler system signage shall include, but not limited to, the following:
  - 1. Identification Signs:
    - a. Provide signage for each control valve, drain valve, sprinkler cabinet, and inspector's test. Securely attach identification signs to valve.
    - b. Provide valve tags for each operable valve. Coordinate nomenclature and identification of operable valves with COR. Where existing nomenclature does not exist, the Tag Identification shall include no less than the following: (FP-B-F/SZ-#) Fire Protection, Building Number, Floor Number/Smoke Zone (if applicable), and Valve Number. (E.g., FP-500-1E-001) Fire Protection, Building 500, First Floor East, Number 001.)
  - 2. Instruction/Information Signs:
    - a. Provide signage for each control valve to indicate valve function and to indicate what system is being controlled.
    - b. Provide signage indicating the number and location of low point drains.
  - 3. Hydraulic Placards:
    - a. Provide signage indicating hydraulic design information. The placard shall include location of the design area, discharge densities, required flow and residual pressure at the base of riser, occupancy classification, hose stream allowance, flow test information,

and installing contractor. Locate hydraulic placard information signs at each alarm check valve.

- P. Repairs: Repair damage to the building or equipment resulting from the installation of the sprinkler system by the installer at no additional expense to the Government.
- Q. Interruption of Service: There shall be no interruption of the existing sprinkler protection, water, electric, or fire alarm services without prior permission of the COR. Contractor shall develop an interim fire protection program where interruptions involve occupied spaces. Request in writing at least one week prior to the planned interruption.

### **3.2 INSPECTION AND TEST**

- A. Preliminary Testing: Flush newly installed systems prior to performing hydrostatic tests in order to remove any debris which may have been left as well as ensuring piping is unobstructed. Hydrostatically test system, including the fire department connections, as specified in NFPA 13, in the presence of the Contracting Officers Representative (COR) or his designated representative. Test and flush underground water line prior to performing these hydrostatic tests.
- B. Final Inspection and Testing: Subject system to tests in accordance with NFPA 13, and when all necessary corrections have been accomplished, advise COR to schedule a final inspection and test. Connection to the fire alarm system shall have been in service for at least ten days prior to the final inspection, with adjustments made to prevent false alarms. Furnish all instruments, labor and materials required for the tests and provide the services of the installation foreman or other competent representative of the installer to perform the tests. Correct deficiencies and retest system as necessary, prior to the final acceptance. Include the operation of all features of the systems under normal operations in test

### **3.3 INSTRUCTIONS**

- A. Furnish the services of a competent instructor for not less than two hours for instructing personnel in the operation and maintenance of the system, on the dates requested by the COR.

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**SECTION 23 05 11**  
**COMMON WORK RESULTS FOR HVAC**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. The requirements of this Section apply to all sections of Division 23.
- B. Definitions:
  - 1. Exposed: Piping, ductwork, and equipment exposed to view in finished rooms.
  - 2. Option or optional: Contractor's choice of an alternate material or method.
  - 3. COR: Contracting Officer's Representative.

**1.2 RELATED WORK**

- A. Section 01 00 00, GENERAL REQUIREMENTS
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES
- C. Section 31 20 00, EARTH MOVING
- D. Section 03 30 00, CAST-IN-PLACE CONCRETE
- E. Section 05 31 00, STEEL DECKING,
- F. Section 05 50 00, METAL FABRICATIONS
- G. Section 07 84 00, FIRESTOPPING
- H. Section 07 60 00, FLASHING AND SHEET METAL
- I. Section 07 92 00, JOINT SEALANTS
- J. Section 09 91 00, PAINTING
- K. Section 23 23 00, REFRIGERANT PIPING
- L. Section 23 81 43, Air-Source Unitary Heat Pumps
- M. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

**1.3 QUALITY ASSURANCE**

- A. Mechanical, electrical and associated systems shall be safe, reliable, efficient, durable, easily and safely operable and maintainable, easily and safely accessible, and in compliance with applicable codes as specified. The systems shall be comprised of high quality institutional-class and industrial-class products of manufacturers that are experienced specialists in the required product lines. All construction firms and personnel shall be experienced and qualified specialists in industrial and institutional HVAC.
- B. Products Criteria:
  - 1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years (or longer as specified elsewhere). The design, model and size of each item shall have been in satisfactory and efficient operation on at least three installations for approximately three years. However, digital electronics devices, software and systems such as controls, instruments, computer work station, shall be the current generation of technology and basic design that has a

- proven satisfactory service record of at least three years. See other specification sections for any exceptions and/or additional requirements.
2. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
  3. Conform to codes and standards as required by the specifications. Conform to local codes, if required by local authorities such as the natural gas supplier, if the local codes are more stringent than those specified. Refer any conflicts to the Contracting Officer's Representative (COR).
  4. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
  5. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
  6. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
  7. Asbestos products or equipment or materials containing asbestos shall not be used.
- E. Equipment Service Organizations:
1. HVAC: Products and systems shall be supported by service organizations that maintain a complete inventory of repair parts and are located within 50 miles to the site.
- F. HVAC Mechanical Systems Welding: Before any welding is performed, contractor shall submit a certificate certifying that welders comply with the following requirements:
1. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualifications".
  2. Comply with provisions of ASME B31 series "Code for Pressure Piping".
  3. Certify that each welder has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.
- G. Execution (Installation, Construction) Quality:
1. Apply and install all items in accordance with manufacturer's written instructions. Refer conflicts between the manufacturer's instructions and the contract drawings and specifications to the COR for resolution. Provide written hard copies or computer files of manufacturer's installation instructions to the COR at least two weeks prior to commencing installation of any item. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations is a cause for rejection of the material.
  2. All items that require access, such as for operating, cleaning, servicing, maintenance, and calibration, shall be easily and safely accessible by persons standing at floor level, or standing on permanent platforms, without the use of portable ladders. Examples of these

items include, but are not limited to: all types of valves, filters and strainers, transmitters, control devices. Prior to commencing installation work, refer conflicts between this requirement and contract drawings to the COR for resolution.

3. Provide complete layout drawings required by Paragraph, SUBMITTALS. Do not commence construction work on any system until the layout drawings have been approved.

- H. Upon request by Government, provide lists of previous installations for selected items of equipment. Include contact persons who will serve as references, with telephone numbers and e-mail addresses.

#### **1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, and with requirements in the individual specification sections.
- B. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements.
- C. If equipment is submitted which differs in arrangement from that shown, provide drawings that show the rearrangement of all associated systems. Approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.
- D. Prior to submitting shop drawings for approval, contractor shall certify in writing that manufacturers of all major items of equipment have each reviewed drawings and specifications, and have jointly coordinated and properly integrated their equipment and controls to provide a complete and efficient installation.
- E. Submittals and shop drawings for interdependent items, containing applicable descriptive information, shall be furnished together and complete in a group. Coordinate and properly integrate materials and equipment in each group to provide a completely compatible and efficient installation. Final review and approval will be made only by groups.
- F. Samples: Samples will not be required, except where materials offered differ from specification requirements. Samples shall be accompanied by full description of characteristics different from specification. The Government, at the Government's expense, will perform evaluation and testing if necessary. The Contractor may submit samples of additional material at the Contractor's option; however, if additional samples of materials are submitted later, pursuant to Government request, adjustment in contract price and time will be made as provided in the GENERAL CONDITIONS.
- G. Mock-ups: Mock-ups are required for critical items and typical component installations replicated numerous times throughout the project as directed by the COR. The COR and Medical Center Representatives shall review and approve the mock-up prior to installation of additional applicable components.
- H. Layout Drawings:

1. Submit complete consolidated and coordinated layout drawings for all new systems, and for existing systems that are in the same areas. Refer to GENERAL CONDITIONS.
2. The drawings shall include plan views, elevations and sections of all systems and shall be on a scale of not less than 1:32 (3/8-inch equal to one foot). Clearly identify and dimension the proposed locations of the principal items of equipment. The drawings shall clearly show locations and adequate clearance for all equipment, piping, valves, control panels and other items. Show the access means for all items requiring access for operations and maintenance. Provide detailed layout drawings of all piping and duct systems.
3. Do not install equipment foundations, equipment or piping until layout drawings have been approved.
4. In addition, for HVAC systems, provide details of the following:
  - a. Mechanical equipment rooms.
  - b. Interstitial space.
  - c. Hangers, inserts, supports, and bracing.
  - d. Pipe sleeves.
  - e. Duct or equipment penetrations of floors, walls, ceilings, or roofs.
- I. Manufacturer's Literature and Data: Submit under the pertinent section rather than under this section.
  1. Submit belt drive with the driven equipment.
  2. Submit electric motor data with the driven equipment.
    - a. Variable speed drive data for motors shall be submitted under the appropriate Division 26 specification section. Coordinate requirements with Electrical Contractor.
  3. Equipment and materials identification.
  4. Fire-stopping materials.
  5. Hangers, inserts, supports and bracing. Provide load calculations for variable spring and constant support hangers.
  6. Wall, floor, and ceiling plates.
- J. HVAC Maintenance Data and Operating Instructions:
  1. Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Article, INSTRUCTIONS, for systems and equipment.
  2. Provide a listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment. Include in the listing belts for equipment: Belt manufacturer, model number, size and style, and distinguished whether of multiple belt sets.
- K. Provide copies of approved HVAC equipment submittals to the Testing, Adjusting and Balancing Subcontractor.

## 1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air Conditioning, Heating and Refrigeration Institute (AHRI):  
430-2009 ..... Central Station Air-Handling Units
- C. American National Standard Institute (ANSI):  
B31.1-2007 ..... Power Piping
- D. Rubber Manufacturers Association (ANSI/RMA):  
IP-20-2007 ..... Specifications for Drives Using Classical V-Belts and Sheaves  
IP-21-2009 ..... Specifications for Drives Using Double-V (Hexagonal) Belts  
IP-22-2007 ..... Specifications for Drives Using Narrow V-Belts and Sheaves
- E. Air Movement and Control Association (AMCA):  
410-96 ..... Recommended Safety Practices for Air Moving Devices
- F. American Society of Mechanical Engineers (ASME):  
Boiler and Pressure Vessel Code (BPVC):  
Section I-2007 ..... Power Boilers  
Section IX-2007 ..... Welding and Brazing Qualifications  
Code for Pressure Piping:  
B31.1-2007 ..... Power Piping
- G. American Society for Testing and Materials (ASTM):  
A36/A36M-08 ..... Standard Specification for Carbon Structural Steel  
A575-96(2007) ..... Standard Specification for Steel Bars, Carbon, Merchant Quality,  
M-Grades  
E84-10 ..... Standard Test Method for Surface Burning Characteristics of  
Building Materials  
E119-09c ..... Standard Test Methods for Fire Tests of Building Construction  
and Materials
- H. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry, Inc:  
SP-58-2009 ..... Pipe Hangers and Supports-Materials, Design and Manufacture,  
Selection, Application, and Installation  
SP 69-2003 ..... Pipe Hangers and Supports-Selection and Application  
SP 127-2001 ..... Bracing for Piping Systems, Seismic – Wind – Dynamic, Design,  
Selection, Application
- I. National Electrical Manufacturers Association (NEMA):  
MG-1-2009 ..... Motors and Generators
- J. National Fire Protection Association (NFPA):  
31-06 ..... Standard for Installation of Oil-Burning Equipment

54-09 .....	National Fuel Gas Code
70-08 .....	National Electrical Code
85-07 .....	Boiler and Combustion Systems Hazards Code
90A-09.....	Standard for the Installation of Air Conditioning and Ventilating Systems
101-09 .....	Life Safety Code

## **1.6 DELIVERY, STORAGE AND HANDLING**

### **A. Protection of Equipment:**

1. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the Government has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage.
2. Place damaged equipment in first class, new operating condition; or, replace same as determined and directed by the COR. Such repair or replacement shall be at no additional cost to the Government.
3. Protect interiors of new equipment and piping systems against entry of foreign matter. Clean both inside and outside before painting or placing equipment in operation.
4. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.

### **B. Cleanliness of Piping and Equipment Systems:**

1. Exercise care in storage and handling of equipment and piping material to be incorporated in the work. Remove debris arising from cutting, threading and welding of piping.
2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
3. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

## **1.7 JOB CONDITIONS – WORK IN EXISTING BUILDING**

- A. Building Operation: Government employees will be continuously operating and managing all facilities, including temporary facilities, that serve the medical center.
- B. Maintenance of Service: Schedule all work to permit continuous service as required by the medical center.
- C. Steam and Condensate Service Interruptions: Limited steam and condensate service interruptions, as required for interconnections of new and existing systems, will be permitted by the COR during periods when the demands are not critical to the operation of the medical center. These non-critical periods are limited to between 8 pm and 5 am in the appropriate off-season (if applicable). Provide at least one week advance notice to the COR.
- D. Phasing of Work: Comply with all requirements shown on drawings or specified.

- E. Building Working Environment: Maintain the architectural and structural integrity of the building and the working environment at all times. Maintain the interior of building at 18 degrees C (65 degrees F) minimum. Limit the opening of doors, windows or other access openings to brief periods as necessary for rigging purposes. No storm water or ground water leakage permitted. Provide daily clean-up of construction and demolition debris on all floor surfaces and on all equipment being operated by VA.
- F. Acceptance of Work for Government Operation: As new facilities are made available for operation and these facilities are of beneficial use to the Government, inspections will be made and tests will be performed. Based on the inspections, a list of contract deficiencies will be issued to the Contractor. After correction of deficiencies as necessary for beneficial use, the Contracting Officer will process necessary acceptance and the equipment will then be under the control and operation of Government personnel.
- G. Temporary Facilities: Refer to Article, TEMPORARY PIPING AND EQUIPMENT in this section.

## **PART 2 - PRODUCTS**

### **2.1 FACTORY-ASSEMBLED PRODUCTS**

- A. Provide maximum standardization of components to reduce spare part requirements.
- B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.
  - 1. All components of an assembled unit need not be products of same manufacturer.
  - 2. Constituent parts that are alike shall be products of a single manufacturer.
  - 3. Components shall be compatible with each other and with the total assembly for intended service.
  - 4. Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.
- C. Components of equipment shall bear manufacturer's name and trademark, model number, serial number and performance data on a name plate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.
- D. Major items of equipment, which serve the same function, must be the same make and model. Exceptions will be permitted if performance requirements cannot be met.

### **2.2 COMPATIBILITY OF RELATED EQUIPMENT**

- A. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational plant that conforms to contract requirements.

### **2.3 BELT DRIVES**

- A. Type: ANSI/RMA standard V-belts with proper motor pulley and driven sheave. Belts shall be constructed of reinforced cord and rubber.

- B. Dimensions, rating and selection standards: ANSI/RMA IP-20 and IP-21.
- C. Minimum Horsepower Rating: Motor horsepower plus recommended ANSI/RMA service factor (not less than 20 percent) in addition to the ANSI/RMA allowances for pitch diameter, center distance, and arc of contact.
- D. Maximum Speed: 25 m/s (5000 feet per minute).
- E. Adjustment Provisions: For alignment and ANSI/RMA standard allowances for installation and take-up.
- F. Drives may utilize a single V-Belt (any cross section) when it is the manufacturer's standard.
- G. Multiple Belts: Matched to ANSI/RMA specified limits by measurement on a belt measuring fixture. Seal matched sets together to prevent mixing or partial loss of sets. Replacement, when necessary, shall be an entire set of new matched belts.
- H. Sheaves and Pulleys:
  - 1. Material: Pressed steel, or close grained cast iron.
  - 2. Bore: Fixed or bushing type for securing to shaft with keys.
  - 3. Balanced: Statically and dynamically.
  - 4. Groove spacing for driving and driven pulleys shall be the same.
- I. Drive Types, Based on ARI 435:
  - 1. Provide adjustable-pitch or fixed-pitch drive as follows:
    - a. Fan speeds up to 1800 RPM: 7.5 kW (10 horsepower) and smaller.
    - b. Fan speeds over 1800 RPM: 2.2 kW (3 horsepower) and smaller.
  - 2. Provide fixed-pitch drives for drives larger than those listed above.
  - 3. The final fan speeds required to just meet the system CFM and pressure requirements, without throttling, shall be determined by adjustment of a temporary adjustable-pitch motor sheave or by fan law calculation if a fixed-pitch drive is used initially.

## **2.4 DRIVE GUARDS**

- A. For machinery and equipment, provide guards as shown in AMCA 410 for belts, chains, couplings, pulleys, sheaves, shafts, gears and other moving parts regardless of height above the floor to prevent damage to equipment and injury to personnel. Drive guards may be excluded where motors and drives are inside factory fabricated air handling unit casings.
- B. Pump shafts and couplings shall be fully guarded by a sheet steel guard, covering coupling and shaft but not bearings. Material shall be minimum 16-gage sheet steel; ends shall be braked and drilled and attached to pump base with minimum of four 6 mm (1/4-inch) bolts. Reinforce guard as necessary to prevent side play forcing guard onto couplings.
- C. V-belt and sheave assemblies shall be totally enclosed, firmly mounted, non-resonant. Guard shall be an assembly of minimum 22-gage sheet steel and expanded or perforated metal to permit observation of belts. 25 mm (one-inch) diameter hole shall be provided at each shaft centerline to permit speed measurement.



- D. Materials: Sheet steel, cast iron, expanded metal or wire mesh rigidly secured so as to be removable without disassembling pipe, duct, or electrical connections to equipment.
- E. Access for Speed Measurement: 25 mm (One inch) diameter hole at each shaft center.

## **2.5 LIFTING ATTACHMENTS**

- A. Provide equipment with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered, without bending or distortion of shape, such as rapid lowering and braking of load.

## **2.6 ELECTRIC MOTORS**

- A. All material and equipment furnished and installation methods shall conform to the requirements of Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT; Section 26 29 11, MOTOR CONTROLLERS, and Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES. Provide all electrical wiring, conduit, and devices necessary for the proper connection, protection and operation of the systems. Provide special energy efficient premium efficiency type motors as scheduled.

## **2.7 NOT USED**

## **2.8 EQUIPMENT AND MATERIALS IDENTIFICATION**

- A. Use symbols, nomenclature and equipment numbers specified, shown on the drawings and shown in the maintenance manuals. Identification for piping and ductwork is specified in Paragraph 3.7 below.
- B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 48 mm (3/16-inch) high of brass with black-filled letters, or rigid black plastic with white letters specified in Section 09 91 00, PAINTING permanently fastened to the equipment. Identify unit components such as coils, filters, fans, etc.
- C. Exterior (Outdoor) Equipment: Brass nameplates, with engraved black filled letters, not less than 48 mm (3/16-inch) high riveted or bolted to the equipment.
- D. Control Items: Label all temperature and humidity sensors, controllers and control dampers. Identify and label each item as they appear on the control diagrams.
- E. Valve Tags and Lists:
  - 1. NOT USED.
  - 2. Valve tags: Engraved black filled numbers and letters not less than 13 mm (1/2-inch) high for number designation, and not less than 6.4 mm(1/4-inch) for service designation on 19 gage 38 mm (1-1/2 inches) round brass disc, attached with brass "S" hook or brass chain.
  - 3. Valve lists: Typed or printed plastic coated card(s), sized 216 mm(8-1/2 inches) by 280 mm (11 inches) showing tag number, valve function and area of control, for each service or system. Punch sheets for a 3-ring notebook.

4. Provide detailed plan for each floor of the building indicating the location and valve number for each valve. Identify location of each valve with a color coded thumb tack in ceiling.

## **2.9 FIRESTOPPING**

- A. Section 07 84 00, FIRESTOPPING specifies an effective barrier against the spread of fire, smoke and gases where penetrations occur for piping and ductwork.

## **2.10 GALVANIZED REPAIR COMPOUND**

- A. Mil. Spec. DOD-P-21035B, paint form.

## **2.11 HVAC PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS**

- A. NOT USED.
- B. Pipe Supports: Comply with MSS SP-58. Type Numbers specified refer to this standard. For selection and application comply with MSS SP-69. Refer to Section 05 50 00, METAL FABRICATIONS, for miscellaneous metal support materials and prime coat painting requirements.
- C. Attachment to Concrete Building Construction:
  1. Concrete insert: MSS SP-58, Type 18.
  2. Self-drilling expansion shields and machine bolt expansion anchors: Permitted in concrete not less than 102 mm (four inches) thick when approved by the COR for each job condition.
  3. Power-driven fasteners: Not permitted.
- D. Attachment to Steel Building Construction:
  1. Welded attachment: MSS SP-58, Type 22.
  2. Beam clamps: MSS SP-58, Types 20, 21, 28 or 29. Type 23 C-clamp may be used for individual copper tubing up to 23mm (7/8-inch) outside diameter.
- E. Attachment to Metal Pan or Deck: As required for materials specified in Section 05 31 00, STEEL DECKING.
- F. Attachment to existing structure: Support from existing floor/roof frame.
- G. Attachment to Wood Construction: Wood screws or lag bolts.
- H. Hanger Rods: Hot-rolled steel, ASTM A36 or A575 for allowable load listed in MSS SP-58. For piping, provide adjustment means for controlling level or slope. Types 13 or 15 turn-buckles shall provide 38 mm (1-1/2 inches) minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.
- I. Hangers Supporting Multiple Pipes (Trapeze Hangers): Galvanized, cold formed, lipped steel channel horizontal member, not less than 41 mm by 41 mm (1-5/8 inches by 1-5/8 inches), 2.7 mm (No. 12 gage), designed to accept special spring held, hardened steel nuts. Not permitted for steam supply and condensate piping.
  1. Allowable hanger load: Manufacturers rating less 91kg (200 pounds).
  2. Guide individual pipes on the horizontal member of every other trapeze hanger with 6 mm (1/4-inch) U-bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two

13mm (1/2-inch) galvanized steel bands, or preinsulated calcium silicate shield for insulated piping at each hanger.

J. Supports for Piping Systems:

1. Select hangers sized to encircle insulation on insulated piping. To protect insulation, provide Type 39 saddles for roller type supports or preinsulated calcium silicate shields. Provide Type 40 insulation shield or preinsulated calcium silicate shield at all other types of supports and hangers including those for preinsulated piping.
2. Piping Systems except High and Medium Pressure Steam (MSS SP-58):
  - a. Standard clevis hanger: Type 1; provide locknut.
  - b. Riser clamps: Type 8.
  - c. Wall brackets: Types 31, 32 or 33.
  - d. Roller supports: Type 41, 43, 44 and 46.
  - e. Saddle support: Type 36, 37 or 38.
  - f. Turnbuckle: Types 13 or 15. Preinsulate.
  - g. U-bolt clamp: Type 24.
  - h. Copper Tube:
    - 1) Hangers, clamps and other support material in contact with tubing shall be painted with copper colored epoxy paint, plastic coated or taped with non adhesive isolation tape to prevent electrolysis.
    - 2) For vertical runs use epoxy painted or plastic coated riser clamps.
    - 3) For supporting tube to strut: Provide epoxy painted pipe straps for copper tube or plastic inserted vibration isolation clamps.
    - 4) Insulated Lines: Provide pre-insulated calcium silicate shields sized for copper tube.
3. High and Medium Pressure Steam (MSS SP-58):
  - a. Provide eye rod or Type 17 eye nut near the upper attachment.
  - b. Piping 50 mm (2 inches) and larger: Type 43 roller hanger. For roller hangers requiring seismic bracing provide a Type 1 clevis hanger with Type 41 roller attached by flat side bars.
  - c. Piping with Vertical Expansion and Contraction:
    - 1) Movement up to 20 mm (3/4-inch): Type 51 or 52 variable spring unit with integral turn buckle and load indicator.
    - 2) Movement more than 20 mm (3/4-inch): Type 54 or 55 constant support unit with integral adjusting nut, turn buckle and travel position indicator.

K. Pre-insulated Calcium Silicate Shields:

1. Provide 360 degree water resistant high density 965 kPa (140 psi) compressive strength calcium silicate shields encased in galvanized metal.
2. Pre-insulated calcium silicate shields to be installed at the point of support during erection.

3. Shield thickness shall match the pipe insulation.
4. The type of shield is selected by the temperature of the pipe, the load it must carry, and the type of support it will be used with.
  - a. Shields for supporting chilled or cold water shall have insulation that extends a minimum of 1 inch past the sheet metal. Provide for an adequate vapor barrier in chilled lines.
  - b. The pre-insulated calcium silicate shield shall support the maximum allowable water filled span as indicated in MSS-SP 69. To support the load, the shields may have one or more of the following features: structural inserts 4138 kPa (600 psi) compressive strength, an extra bottom metal shield, or formed structural steel (ASTM A36) wear plates welded to the bottom sheet metal jacket.
5. Shields may be used on steel clevis hanger type supports, roller supports or flat surfaces.

## **2.12 PIPE PENETRATIONS**

- A. Install sleeves during construction for other than blocked out floor openings for risers in mechanical bays.
- B. To prevent accidental liquid spills from passing to a lower level, provide the following:
  1. For sleeves: Extend sleeve 25 mm (one inch) above finished floor and provide sealant for watertight joint.
  2. For blocked out floor openings: Provide 40 mm (1-1/2 inch) angle set in silicone adhesive around opening.
  3. For drilled penetrations: Provide 40 mm (1-1/2 inch) angle ring or square set in silicone adhesive around penetration.
- C. Penetrations are not allowed through beams or ribs, but may be installed in concrete beam flanges. Any deviation from these requirements must receive prior approval of COR.
- D. Sheet Metal, Plastic, or Moisture-resistant Fiber Sleeves: Provide for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.
- E. Cast Iron or Zinc Coated Pipe Sleeves: Provide for pipe passing through exterior walls below grade. Make space between sleeve and pipe watertight with a modular or link rubber seal. Seal shall be applied at both ends of sleeve.
- F. Galvanized Steel or an alternate Black Iron Pipe with asphalt coating Sleeves: Provide for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for. Provide sleeve for pipe passing through floor of mechanical rooms. Except in mechanical rooms, connect sleeve with floor plate.
- G. Brass Pipe Sleeves: Provide for pipe passing through quarry tile, terrazzo or ceramic tile floors. Connect sleeve with floor plate.
- H. Sleeves are not required for wall hydrants for fire department connections or in drywall construction.

- I. Sleeve Clearance: Sleeve through floors, walls, partitions, and beam flanges shall be one inch greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation. Interior openings shall be caulked tight with fire stopping material and sealant to prevent the spread of fire, smoke, and gases.
- J. Sealant and Adhesives: Shall be as specified in Section 07 92 00, JOINT SEALANTS.

## **2.13 DUCT PENETRATIONS**

- A. Provide firestopping for openings through fire and smoke barriers, maintaining minimum required rating of floor, ceiling or wall assembly. See section 07 84 00, FIRESTOPPING.

## **2.14 SPECIAL TOOLS AND LUBRICANTS**

- A. Furnish, and turn over to the COR, tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.
- B. Grease Guns with Attachments for Applicable Fittings: One for each type of grease required for each motor or other equipment.
- C. Refrigerant Tools: Provide system charging/Evacuation equipment, gauges, fittings, and tools required for maintenance of furnished equipment.
- D. Tool Containers: Hardwood or metal, permanently identified for intended service and mounted, or located, where directed by the COR.
- E. Lubricants: A minimum of 0.95 L (one quart) of oil, and 0.45 kg (one pound) of grease, of equipment manufacturer's recommended grade and type, in unopened containers and properly identified as to use for each different application.

## **2.15 WALL, FLOOR AND CEILING PLATES**

- A. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.
- B. Thickness: Not less than 2.4 mm (3/32-inch) for floor plates. For wall and ceiling plates, not less than 0.64 mm (0.025-inch) for up to 80 mm (3-inch pipe), 0.89 mm (0.035-inch) for larger pipe.
- C. Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. Provide a watertight joint in spaces where brass or steel pipe sleeves are specified.

## **2.16 ASBESTOS**

- A. Materials containing asbestos are not permitted.

## **PART 3 - EXECUTION**

### **3.1 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING**

- A. Coordinate location of piping, sleeves, inserts, hangers, ductwork and equipment. Locate piping, sleeves, inserts, hangers, ductwork and equipment clear of windows, doors, openings, light outlets, and other services and utilities. Prepare equipment layout drawings to coordinate proper location and personnel access of all facilities. Submit the drawings for review as required by Part

1. Follow manufacturer's published recommendations for installation methods not otherwise specified.
- B. Operating Personnel Access and Observation Provisions: Select and arrange all equipment and systems to provide clear view and easy access, without use of portable ladders, for maintenance and operation of all devices including, but not limited to: all equipment items, valves, filters, strainers, transmitters, sensors, control devices. All gages and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms. Do not reduce or change maintenance and operating space and access provisions that are shown on the drawings.
- C. Equipment and Piping Support: Coordinate structural systems necessary for pipe and equipment support with pipe and equipment locations to permit proper installation.
- D. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.
- E. Cutting Holes:
  1. Cut holes through concrete and masonry by rotary core drill. Pneumatic hammer, impact electric, and hand or manual hammer type drill will not be allowed, except as permitted by COR where working area space is limited.
  2. Locate holes to avoid interference with structural members such as beams or grade beams. Holes shall be laid out in advance and drilling done only after approval by COR. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to COR for approval.
  3. Do not penetrate membrane waterproofing.
- F. Interconnection of Instrumentation or Control Devices: Generally, electrical and pneumatic interconnections are not shown but must be provided.
- G. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.
- H. Electrical and Pneumatic Interconnection of Controls and Instruments: This generally not shown but must be provided. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, instruments and computer workstations. Comply with NFPA-70.
- I. Protection and Cleaning:
  1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the COR. Damaged or defective items in the opinion of the COR, shall be replaced.
  2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and

- equipment against dirt, water chemical, or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.
- J. Concrete and Grout: Use concrete and shrink compensating grout 25 MPa (3000 psi) minimum, specified in Section 03 30 00, CAST-IN-PLACE CONCRETE.
- K. Install gages, thermometers, valves and other devices with due regard for ease in reading or operating and maintaining said devices. Locate and position thermometers and gages to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.
- L. Work in Existing Building:
1. Perform as specified in Article, OPERATIONS AND STORAGE AREAS, Article, ALTERATIONS, and Article, RESTORATION of the Section 01 00 00, GENERAL REQUIREMENTS for relocation of existing equipment, alterations and restoration of existing building(s).
  2. As specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, OPERATIONS AND STORAGE AREAS, make alterations to existing service piping at times that will least interfere with normal operation of the facility.
  3. Cut required openings through existing masonry and reinforced concrete using diamond core drills. Use of pneumatic hammer type drills, impact type electric drills, and hand or manual hammer type drills, will be permitted only with approval of the COR. Locate openings that will least effect structural slabs, columns, ribs or beams. Refer to the COR for determination of proper design for openings through structural sections and opening layouts approval, prior to cutting or drilling into structure. After COR's approval, carefully cut opening through construction no larger than absolutely necessary for the required installation.
- M. Switchgear/Electrical Equipment Drip Protection: Every effort shall be made to eliminate the installation of pipe above electrical and telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints. Installation of piping, ductwork, leak protection apparatus or other installations foreign to the electrical installation shall not be located in the space equal to the width and depth of the equipment and extending from the floor to a height of 1.8 m (6 ft.) above the equipment or to structural ceiling, whichever is lower (NFPA 70).
- N. Inaccessible Equipment:
1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost to the Government.
  2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

### **3.2 TEMPORARY PIPING AND EQUIPMENT**

- A. Continuity of operation of existing facilities will generally require temporary installation or relocation of equipment and piping.
- B. The Contractor shall provide all required facilities in accordance with the requirements of phased construction and maintenance of service. All piping and equipment shall be properly supported, sloped to drain, operate without excessive stress, and shall be insulated where injury can occur to personnel by contact with operating facilities. The requirements of Paragraph 3.1 apply.
- C. Temporary facilities and piping shall be completely removed and any openings in structures sealed. Provide necessary blind flanges and caps to seal open piping remaining in service.

### **3.3 RIGGING**

- A. Design is based on application of available equipment. Openings in building structures are planned to accommodate design scheme.
- B. Alternative methods of equipment delivery may be offered by Contractor and will be considered by Government under specified restrictions of phasing and maintenance of service as well as structural integrity of the building.
- C. Close all openings in the building when not required for rigging operations to maintain proper environment in the facility for Government operation and maintenance of service.
- D. Contractor shall provide all facilities required to deliver specified equipment and place on foundations. Attachments to structures for rigging purposes and support of equipment on structures shall be Contractor's full responsibility. Upon request, the Government will check structure adequacy and advise Contractor of recommended restrictions.
- E. Contractor shall check all clearances, weight limitations and shall offer a rigging plan designed by a Registered Professional Engineer. All modifications to structures, including reinforcement thereof, shall be at Contractor's cost, time and responsibility.
- F. Rigging plan and methods shall be referred to COR for evaluation prior to actual work.
- G. Restore building to original condition upon completion of rigging work.

### **3.4 PIPE AND EQUIPMENT SUPPORTS**

- A. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels secured directly to joist and rib structure that will correspond to the required hanger spacing, and then suspend the equipment and piping from the channels. Drill or burn holes in structural steel only with the prior approval of the COR.
- B. Use of chain, wire or strap hangers; wood for blocking, stays and bracing; or, hangers suspended from piping above will not be permitted. Replace or thoroughly clean rusty products and paint with zinc primer.
- C. Use hanger rods that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. Provide a minimum of 15 mm (1/2-inch) clearance between pipe or piping covering and adjacent work.



- D. HVAC Horizontal Pipe Support Spacing: Refer to MSS SP-69. Provide additional supports at valves, strainers, in-line pumps and other heavy components. Provide a support within one foot of each elbow.
- E. HVAC Vertical Pipe Supports:
  - 1. Up to 150 mm (6-inch pipe), 9 m (30 feet) long, bolt riser clamps to the pipe below couplings, or welded to the pipe and rest supports securely on the building structure.
  - 2. Vertical pipe larger than the foregoing, support on base elbows or tees, or substantial pipe legs extending to the building structure.
- F. Overhead Supports:
  - 1. The basic structural system of the building is designed to sustain the loads imposed by equipment and piping to be supported overhead.
  - 2. Provide steel structural members, in addition to those shown, of adequate capability to support the imposed loads, located in accordance with the final approved layout of equipment and piping.
  - 3. Tubing and capillary systems shall be supported in channel troughs.
- G. Floor Supports:
  - 1. Provide concrete bases, concrete anchor blocks and pedestals, and structural steel systems for support of equipment and piping. Anchor and dowel concrete bases and structural systems to resist forces under operating and seismic conditions (if applicable) without excessive displacement or structural failure.
  - 2. Do not locate or install bases and supports until equipment mounted thereon has been approved. Size bases to match equipment mounted thereon plus 50 mm (2 inch) excess on all edges. Refer to structural drawings. Bases shall be neatly finished and smoothed, shall have chamfered edges at the top, and shall be suitable for painting.
  - 3. All equipment shall be shimmed, leveled, firmly anchored, and grouted with epoxy grout. Anchor bolts shall be placed in sleeves, anchored to the bases. Fill the annular space between sleeves and bolts with a granular material to permit alignment and realignment.

### **3.5 MECHANICAL DEMOLITION**

- A. Rigging access, other than indicated on the drawings, shall be provided by the Contractor after approval for structural integrity by the COR. Such access shall be provided without additional cost or time to the Government. Where work is in an operating facility, provide approved protection from dust and debris at all times for the safety of facility patients & personnel, and maintenance of facility operation and environment of the facility.
- B. In an operating facility, maintain the operation, cleanliness and safety. Government personnel will be carrying on their normal duties of operating, cleaning and maintaining equipment and plant operation. Confine the work to the immediate area concerned; maintain cleanliness and wet down demolished materials to eliminate dust. Do not permit debris to accumulate in the area to

the detriment of plant operation. Perform all flame cutting to maintain the fire safety integrity of this plant. Adequate fire extinguishing facilities shall be available at all times. Perform all work in accordance with recognized fire protection standards. Inspection will be made by personnel of the VA Medical Center, and Contractor shall follow all directives of the COR with regard to rigging, safety, fire safety, and maintenance of operations.

- C. Completely remove all piping, wiring, conduit, and other devices associated with the equipment not to be re-used in the new work. This includes all pipe, valves, fittings, insulation, and all hangers including the top connection and any fastenings to building structural systems. Seal all openings, after removal of equipment, pipes, ducts, and other penetrations in roof, walls, floors, in an approved manner and in accordance with plans and specifications where specifically covered. Structural integrity of the building system shall be maintained. Reference shall also be made to the drawings and specifications of the other disciplines in the project for additional facilities to be demolished or handled.
- D. All valves including gate, globe, ball, butterfly and check, all pressure gages and thermometers with wells shall remain Government property and shall be removed and delivered to COR and stored as directed. The Contractor shall remove all other material and equipment, devices and demolition debris under these plans and specifications. Such material shall be removed from Government property expeditiously and shall not be allowed to accumulate.

### **3.6 CLEANING AND PAINTING**

- A. Prior to final inspection and acceptance of the plant and facilities for beneficial use by the Government, the plant facilities, equipment and systems shall be thoroughly cleaned and painted. Refer to Section 09 91 00, PAINTING.
- B. In addition, the following special conditions apply:
  - 1. Cleaning shall be thorough. Use solvents, cleaning materials and methods recommended by the manufacturers for the specific tasks. Remove all rust prior to painting and from surfaces to remain unpainted. Repair scratches, scuffs, and abrasions prior to applying prime and finish coats.
  - 2. Material And Equipment Not To Be Painted Includes:
    - a. Motors, controllers, control switches, and safety switches.
    - b. Control and interlock devices.
    - c. Regulators.
    - d. Pressure reducing valves.
    - e. Control valves and thermostatic elements.
    - f. Lubrication devices and grease fittings.
    - g. Copper, brass, aluminum, stainless steel and bronze surfaces.
    - h. Valve stems and rotating shafts.
    - i. Pressure gauges and thermometers.

- j. Glass.
- k. Name plates.
- 3. Control and instrument panels shall be cleaned, damaged surfaces repaired, and shall be touched-up with matching paint obtained from panel manufacturer.
- 4. Pumps, motors, steel and cast iron bases, and coupling guards shall be cleaned, and shall be touched-up with the same color as utilized by the pump manufacturer
- 5. Temporary Facilities: Apply paint to surfaces that do not have existing finish coats.
- 6. Paint shall withstand the following temperatures without peeling or discoloration:
  - a. Condensate -- 38 degrees C (100 degrees F) on insulation jacket surface and 120 degrees C (250 degrees F) on metal pipe surface.
  - b. Steam -- 52 degrees C (125 degrees F) on insulation jacket surface and 190 degrees C (375 degrees F) on metal pipe surface.
- 7. Final result shall be smooth, even-colored, even-textured factory finish on all items.  
Completely repaint the entire piece of equipment if necessary to achieve this.

### **3.7 IDENTIFICATION SIGNS**

- A. Provide laminated plastic signs, with engraved lettering not less than 5 mm (3/16-inch) high, designating functions, for all equipment, switches, motor controllers, relays, meters, control devices, including automatic control valves. Nomenclature and identification symbols shall correspond to that used in maintenance manual, and in diagrams specified elsewhere. Attach by chain, adhesive, or screws.
- B. Factory Built Equipment: Metal plate, securely attached, with name and address of manufacturer, serial number, model number, size, performance.
- C. Pipe Identification: Pipe marking shall be applied to all pipes after insulation and painting has been completed, and shall be as follows:
  - 1. Plastic semi-rigid snap-on type, manufacturer's standard pre-printed color coded pipe markers extending fully around the pipe and insulation or pressure-sensitive vinyl markers.
  - 2. On piping and insulation 6" and greater diameter, full band as specified above or strip-type markers fastened to the pipe or insulation with laminated or bonded application or by color-coded plastic tape not less than 1.50" wide, full circle at both ends of the marker
  - 3. Arrows for direction of flow provided integral with the pipe marker or separate at each marker.
- D. Duct Identification: Duct marking shall be applied to all ducts, after insulation and painting has been completed, and shall be as follows:
  - 1. Laminated plastic color-coded pressure sensitive vinyl tape, 2.50" width, 3 mils minimum thickness. Identification shall include service (supply, return, exhaust, outside air) and direction of flow.
  - 2. Duct access panel markings shall be similar to duct markings to identify the device (fire damper, smoke damper, control damper, smoke detector, etc.

3. Arrows for direction of flow provided integral with the pipe marker or separate at each marker.
- E. For pipe & duct labeling, coordinate names, abbreviations and other designations used in mechanical identification work, with corresponding designations shown, specified or scheduled on drawings. Pipe and duct markings shall be placed:
  1. At each piece of equipment.
  2. At 25 ft. centers in mechanical rooms and concealed spaces, but at least once per room.
  3. At 50 ft. centers in other exposed locations.
  4. On mains at each branch take-off.
  5. On duct access panels.

### **3.8 MOTOR AND DRIVE ALIGNMENT**

- A. Belt Drive: Set driving and driven shafts parallel and align so that the corresponding grooves are in the same plane.
- B. Direct-connect Drive: Securely mount motor in accurate alignment so that shafts are free from both angular and parallel misalignment when both motor and driven machine are operating at normal temperatures.

### **3.9 LUBRICATION**

- A. Lubricate all devices requiring lubrication prior to initial operation. Field-check all devices for proper lubrication.
- B. Equip all devices with required lubrication fittings or devices. Provide a minimum of one liter (one quart) of oil and 0.5 kg (one pound) of grease of manufacturer's recommended grade and type for each different application; also provide 12 grease sticks for lubricated plug valves. Deliver all materials to COR in unopened containers that are properly identified as to application.
- C. Provide a separate grease gun with attachments for applicable fittings for each type of grease applied.
- D. All lubrication points shall be accessible without disassembling equipment, except to remove access plates.

### **3.10 NOT USED**

### **3.11 STARTUP AND TEMPORARY OPERATION**

- A. Start up equipment as described in equipment specifications. Verify that vibration is within specified tolerance prior to extended operation. Temporary use of equipment is specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT.

### **3.12 OPERATING AND PERFORMANCE TESTS**

- A. Prior to the final inspection, perform required tests as specified in Section 01 00 00, GENERAL REQUIREMENTS and submit the test reports and records to the COR.

- B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost to the Government.
- C. When completion of certain work or system occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then make performance tests for heating systems and for cooling systems respectively during first actual seasonal use of respective systems following completion of work.

**3.13 INSTRUCTIONS TO VA PERSONNEL**

- A. Provide in accordance with Article, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.

--- E N D ---

**SECTION 23 23 00**  
**REFRIGERANT PIPING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Factory or field refrigerant piping for direct expansion HVAC systems, including required pipe insulation.
- B. Refrigerant piping shall be sized, selected, and designed either by the equipment manufacturer or in strict accordance with the manufacturer's published instructions. The refrigerant piping diagram shall show all accessories such as, stop valves, level indicators, liquid receivers, oil separator, gauges, thermostatic expansion valves, solenoid valves, moisture separators and driers to make a complete installation.
- C. Definitions:
  - 1. Refrigerating system: Combination of interconnected refrigerant-containing parts constituting one closed refrigeration circuit in which a refrigerant is circulated for the purpose of extracting heat.
    - a. Low side means the parts of a refrigerating system subjected to evaporator pressure.
    - b. High side means the parts of a refrigerating system subjected to condenser pressure.
  - 2. Brazed joint: A gas-tight joint obtained by the joining of metal parts with alloys which melt at temperatures higher than 449 degrees C (840 degrees F) but less than the melting temperatures of the joined parts.

**1.2 RELATED WORK**

- A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items, which are common to more than one section of Division 23.
- B. 23 81 43, Air-Source Unitary Heat Pumps.

**1.3 QUALITY ASSURANCE**

- A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Comply with ASHRAE Standard 15, Safety Code for Mechanical Refrigeration. The application of this Code is intended to assure the safe design, construction, installation, operation, and inspection of every refrigerating system employing a fluid which normally is vaporized and liquefied in its refrigerating cycle.
- C. Comply with ASME B31.5: Refrigerant Piping and Heat Transfer Components.
- D. Products shall comply with UL 207 "Refrigerant-Containing Components and Accessories, "Nonelectrical"; or UL 429 "Electrical Operated Valves."

**1.4 SUBMITTALS**

- A. Submit in accordance with specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings:

1. Complete information for components noted, including valves and refrigerant piping accessories, clearly presented, shall be included to determine compliance with drawings and specifications for components noted below:
  - a. Tubing and fittings
  - b. Valves
  - c. Strainers
  - d. Moisture-liquid indicators
  - e. Filter-driers
  - f. Flexible metal hose
  - g. Liquid-suction interchanges
  - h. Oil separators (when specified)
  - i. Gages
  - j. Pipe and equipment supports
  - k. Refrigerant and oil
  - l. Pipe/conduit roof penetration cover
  - m. Soldering and brazing materials
2. Layout of refrigerant piping and accessories, including flow capacities, valves locations, and oil traps slopes of horizontal runs, floor/wall penetrations, and equipment connection details.
- C. Certification: Copies of certificates for welding procedure, performance qualification record and list of welders' names and symbols.
- D. Design Manual: Furnish two copies of design manual of refrigerant valves and accessories.

#### **1.5 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air Conditioning, Heating, and Refrigeration Institute (ARI/AHRI):
  - 495-1999 (R2002) ..... Standard for Refrigerant Liquid Receivers
  - 730-2005 ..... Flow Capacity Rating of Suction-Line Filters and Suction-Line Filter-Driers
  - 750-2007 ..... Thermostatic Refrigerant Expansion Valves
  - 760-2007 ..... Performance Rating of Solenoid Valves for Use with Volatile Refrigerants
- C. American Society of Heating Refrigerating and Air Conditioning Engineers (ASHRAE):
  - ANSI/ASHRAE 15-2007 ..... Safety Standard for Refrigeration Systems (ANSI)
  - ANSI/ASHRAE 17-2008 ..... Method of Testing Capacity of Thermostatic Refrigerant Expansion Valves (ANSI)
  - 63.1-95 (RA 01) ..... Method of Testing Liquid Line Refrigerant Driers (ANSI)
- D. American National Standards Institute (ANSI):

- ASME (ANSI)A13.1-2007 ..... Scheme for Identification of Piping Systems  
Z535.1-2006..... Safety Color Code
- E. American Society of Mechanical Engineers (ASME):  
ANSI/ASME B16.22-2001 (R2005)  
Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings (ANSI)  
ANSI/ASME B16.24-2006      Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class  
150, 300, 400, 600, 900, 1500 and 2500 (ANSI)  
ANSI/ASME B31.5-2006..... Refrigeration Piping and Heat Transfer Components (ANSI)  
ANSI/ASME B40.100-2005..... Pressure Gauges and Gauge Attachments  
ANSI/ASME B40.200-2008..... Thermometers, Direct Reading and Remote Reading
- F. American Society for Testing and Materials (ASTM)  
A126-04..... Standard Specification for Gray Iron Castings for Valves,  
Flanges, and Pipe FittingsB32-08      Standard Specification  
for Solder Metal  
B88-03..... Standard Specification for Seamless Copper Water Tube  
B88M-05..... Standard Specification for Seamless Copper Water Tube  
(Metric)  
B280-08..... Standard Specification for Seamless Copper Tube for Air  
Conditioning and Refrigeration Field Service
- G. American Welding Society, Inc. (AWS):  
Braze Handbook  
A5.8/A5.8M-04 ..... Standard Specification for Filler Metals for Brazing and Braze  
Welding
- H. Federal Specifications (Fed. Spec.)  
Fed. Spec. GG
- I. Underwriters Laboratories (U.L.):  
U.L.207-2009 ..... Standard for Refrigerant-Containing Components and  
Accessories, Nonelectrical  
U.L.429-99 (Rev.2006) ..... Standard for Electrically Operated Valves

## **PART 2 - PRODUCTS**

### **2.1 PIPING AND FITTINGS**

- A. Refrigerant Piping: For piping up to 100 mm (4 inch) use Copper refrigerant tube, ASTM B280, cleaned, dehydrated and sealed, marked ACR on hard temper straight lengths. Coils shall be tagged ASTM B280 by the manufacturer. For piping over 100 mm (4 inch) use A53 Black SML steel.
- B. Water and Drain Piping: Copper water tube, ASTM B88M, Type B or C (ASTM B88, Type M or L).



C. Fittings, Valves and Accessories:

1. Copper fittings: Wrought copper fittings, ASME B16.22.
  - a. Brazed Joints, refrigerant tubing: Cadmium free, AWS A5.8/A5.8M, 45 percent silver brazing alloy, Class BAg-5.
  - b. Solder Joints, water and drain: 95-5 tin-antimony, ASTM B32 (95TA).
2. Steel fittings: ASTM wrought steel fittings.
  - a. Refrigerant piping – Welded Joints.
3. Flanges and flanged fittings: ASME B16.24.
4. Refrigeration Valves:
  - a. Stop Valves: Brass or bronze alloy, packless, or packed type with gas tight cap, frost proof, back seating.
  - b. Pressure Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; UL listed. Forged brass with nonferrous, corrosion resistant internal working parts of high strength, cast iron bodies conforming to ASTM A126, Grade B. Set valves in accordance with ASHRAE Standard 15.
  - c. Solenoid Valves: Comply with ARI 760 and UL 429, UL-listed, two-position, direct acting or pilot-operated, moisture and vapor-proof type of corrosion resisting materials, designed for intended service, and solder-end connections. Fitted with suitable NEMA 250 enclosure of type required by location and normally open or closed holding coil as appropriate.
  - d. Thermostatic Expansion Valves: Comply with ARI 750. Brass body with stainless-steel or non-corrosive non ferrous internal parts, diaphragm and spring-loaded (direct-operated) type with sensing bulb and distributor having side connection for hot-gas bypass and external equalizer. Size and operating characteristics as recommended by manufacturer of evaporator and factory set for superheat requirements. Solder-end connections. Testing and rating in accordance with ASHRAE Standard 17.
  - e. Check Valves: Brass or bronze alloy with swing or lift type, with tight closing resilient seals for silent operation; designed for low pressure drop, and with solder-end connections. Direction of flow shall be legibly and permanently indicated on the valve body.
5. Strainers: Designed to permit removing screen without removing strainer from piping system, and provided with screens 80 to 100 mesh in liquid lines DN 25 (NPS 1) and smaller, 60 mesh in liquid lines larger than DN 25 (NPS 1), and 40 mesh in suction lines. Provide strainers in liquid line serving each thermostatic expansion valve, and in suction line serving each refrigerant compressor not equipped with integral strainer.

6. Refrigerant Moisture/Liquid Indicators: Double-ported type having heavy sight glasses sealed into forged bronze body and incorporating means of indicating refrigerant charge and moisture indication. Provide screwed brass seal caps.
7. Refrigerant Filter-Dryers: UL listed, angle or in-line type, as shown on drawings. Conform to ARI Standard 730 and ASHRAE Standard 63.1. Heavy gage steel shell protected with corrosion-resistant paint; perforated baffle plates to prevent desiccant bypass. Size as recommended by manufacturer for service and capacity of system with connection not less than the line size in which installed. Filter driers with replaceable filters shall be furnished with one spare element of each type and size.
8. Flexible Metal Hose: Seamless bronze corrugated hose, covered with bronze wire braid, with standard copper tube ends. Provide in suction and discharge piping of each compressor.
9. Receivers (where required by equipment manufacturer): Conform to AHRI 495, steel construction, equipped with tappings for liquid inlet and outlet valves, pressure relief valve and liquid level indicator.

## **2.2 GAGES**

- A. Temperature Gages: Comply with ASME B40.200. Industrial-duty type and in required temperature range for service in which installed. Gages shall have Celsius scale in 1-degree (Fahrenheit scale in 2-degree) graduations and with black number on a white face. The pointer shall be adjustable. Rigid stem type temperature gages shall be provided in thermal wells located within 1525 mm (5 feet) of the finished floor. Universal adjustable angle type or remote element type temperature gages shall be provided in thermal wells located 1525 to 2135 mm (5 to 7 feet) above the finished floor. Remote element type temperature gages shall be provided in thermal wells located 2135 mm (7 feet) above the finished floor.
- B. Vacuum and Pressure Gages: Comply with ASME B40.100 and provide with throttling type needle valve or a pulsation dampener and shut-off valve. Gage shall be a minimum of 90 mm (3-1/2 inches) in diameter with a range from 0 kPa (0 psig) to approximately 1.5 times the maximum system working pressure. Each gage range shall be selected so that at normal operating pressure, the needle is within the middle-third of the range.
  1. Suction: 101 kPa (30 inches Hg) vacuum to 1723 kPa (gage) (250 psig).
  2. Discharge: 0 to 3445 kPa (gage) (0 to 500 psig).

## **2.3 PIPE SUPPORTS**

- A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

## **2.4 REFRIGERANTS AND OIL**

- A. Provide EPA approved refrigerant and oil for proper system operation.

## **2.5 PIPE INSULATION FOR DX HVAC SYSTEMS**

- A. Refer to specification Section 23 07 11, HVAC AND BOILER PLANT INSULATION.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install refrigerant piping and refrigerant containing parts in accordance with ASHRAE Standard 15 and ASME B31.5
  - 1. Install piping as short as possible, with a minimum number of joints, elbow and fittings.
  - 2. Install piping with adequate clearance between pipe and adjacent walls and hangers to allow for service and inspection. Space piping, including insulation, to provide 25 mm (1 inch) minimum clearance between adjacent piping or other surface. Use pipe sleeves through walls, floors, and ceilings, sized to permit installation of pipes with full thickness insulation.
  - 3. Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Generally locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown on the drawing.
  - 4. Use copper tubing in protective conduit when installed below ground.
  - 5. Install hangers and supports per ASME B31.5 and the refrigerant piping manufacturer's recommendations.
- B. Joint Construction:
  - 1. Brazed Joints: Comply with AWS "Brazing Handbook" and with filler materials complying with AWS A5.8/A5.8M.
    - a. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper tubing.
    - b. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.
    - c. Swab fittings and valves with manufacturer's recommended cleaning fluid to remove oil and other compounds prior to installation.
    - d. Pass nitrogen gas through the pipe or tubing to prevent oxidation as each joint is brazed. Cap the system with a reusable plug after each brazing operation to retain the nitrogen and prevent entrance of air and moisture.
- C. Protect refrigerant system during construction against entrance of foreign matter, dirt and moisture; have open ends of piping and connections to compressors, condensers, evaporators and other equipment tightly capped until assembly.
- D. Pipe relief valve discharge to outdoors for systems containing more than 45 kg (100 lbs) of refrigerant.
- E. Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material. For firestopping insulated piping refer to Section 23 07 11, HVAC AND BOILER PLANT INSULATION.

### **3.2 PIPE AND TUBING INSULATION**

- A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

- B. Apply two coats of weather-resistant finish as recommended by the manufacturer to insulation exposed to outdoor weather.

### **3.3 SIGNS AND IDENTIFICATION**

- A. Each refrigerating system erected on the premises shall be provided with an easily legible permanent sign securely attached and easily accessible, indicating thereon the name and address of the installer, the kind and total number of pounds of refrigerant required in the system for normal operations, and the field test pressure applied.
- B. Systems containing more than 50 kg (110 lb) of refrigerant shall be provided with durable signs, in accordance with ANSI A13.1 and ANSI Z535.1, having letters not less than 13 mm (1/2 inch) in height designating:
  - 1. Valves and switches for controlling refrigerant flow, the ventilation and the refrigerant compressor(s).
  - 2. Signs on all exposed high pressure and low pressure piping installed outside the machinery room, with name of the refrigerant and the letters "HP" or "LP."

### **3.4 FIELD QUALITY CONTROL**

- A. Prior to initial operation, examine and inspect piping system for conformance to plans and specifications and ASME B31.5. Correct equipment, material, or work rejected because of defects or nonconformance with plans and specifications, and ANSI codes for pressure piping.
- B. After completion of piping installation and prior to initial operation, conduct test on piping system according to ASME B31.5. Furnish materials and equipment required for tests. Perform tests in the presence of the COR. If the test fails, correct defects and perform the test again until it is satisfactorily done and all joints are proved tight.
  - 1. Every refrigerant-containing parts of the system that is erected on the premises, except compressors, condensers, evaporators, safety devices, pressure gages, control mechanisms and systems that are factory tested, shall be tested and proved tight after complete installation, and before operation.
  - 2. The high and low side of each system shall be tested and proved tight at not less than the lower of the design pressure or the setting of the pressure-relief device protecting the high or low side of the system, respectively, except systems erected on the premises using non-toxic and non-flammable Group A1 refrigerants with copper tubing not exceeding DN 18 (NPS 5/8). This may be tested by means of the refrigerant charged into the system at the saturated vapor pressure of the refrigerant at 20 degrees C (68 degrees F) minimum.
- C. Test Medium: A suitable dry gas such as nitrogen or shall be used for pressure testing. The means used to build up test pressure shall have either a pressure-limiting device or pressure-reducing device with a pressure-relief device and a gage on the outlet side. The pressure relief device shall be set above the test pressure but low enough to prevent permanent deformation of the system components.

### 3.5 SYSTEM TEST AND CHARGING

- A. System Test and Charging: As recommended by the equipment manufacturer or as follows:
1. Connect a drum of refrigerant to charging connection and introduce enough refrigerant into system to raise the pressure to 70 kPa (10 psi) gage. Close valves and disconnect refrigerant drum. Test system for leaks with halide test torch or other approved method suitable for the test gas used. Repair all leaking joints and retest.
  2. Connect a drum of dry nitrogen to charging valve and bring test pressure to design pressure for low side and for high side. Test entire system again for leaks.
  3. Evacuate the entire refrigerant system by the triplicate evacuation method with a vacuum pump equipped with an electronic gage reading in mPa (microns). Pull the system down to 665 mPa (500 microns) 665 mPa (2245.6 inches of mercury at 60 degrees F) and hold for four hours then break the vacuum with dry nitrogen (or refrigerant). Repeat the evacuation two more times breaking the third vacuum with the refrigeration to be charged and charge with the proper volume of refrigerant.

--- E N D ---

**SECTION 23 81 43**  
**AIR-SOURCE UNITARY HEAT PUMPS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section specifies electrically operated air-source unitary heat pumps.
- B. Definitions:
  - 1. Coefficient of Performance (COP) - Cooling: The ratio of the rate of heat removed to the rate of energy input in consistent units, for a complete refrigerating system or some specific portion of that system under designated operating conditions.
  - 2. Coefficient of Performance (COP) - Heating: The ratio of the rate of heat delivered to the rate of energy input is consistent units for a complete heat pump system, including the compressor and, if applicable, auxiliary heat under designated operating conditions.
  - 3. Energy Efficiency Ratio (EER): The ratio of net cooling capacity is Btu/h to total rate of electricity input in watts under designated operating conditions.
  - 4. Heating Seasonal Performance Factor (HSPF) - Total heating output of heat pump during its normal annual usage period for heating in Btu/h divided by total electric energy input in watts during the same period.
  - 5. Seasonal Energy Efficiency Ratio (SEER) - Total cooling output of an air conditioner during its normal annual usage period for cooling in Btu/h divided by total electric energy input in watts during the same period.
  - 6. Air-Source Unitary Heat Pump: One or more factory made assemblies that normally include an indoor conditioning coil, compressor(s) and an outdoor refrigerant-to-air coil. These units provide both heating and cooling functions.

**1.2 RELATED WORK**

- A. Section 01 00 00, GENERAL REQUIREMENTS: For pre-test requirements.
- B. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items, which are common to more than one section of Division 23.
- C. Section 23 23 00, REFRIGERANT PIPING: Requirements for field refrigerant piping.

**1.3 QUALITY ASSURANCE:**

- A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC
- B. Comply with ASHRAE Standard 15, Safety Code for Mechanical Refrigeration.
- C. Comply with ASHRAE Standard 90.1-2010, Energy Standard for Buildings except Low-Rise Residential Buildings for cooling and heating performance requirements when tested in accordance with AHRI 210/240 and UL 1995.
- D. Heating Performance shall conform to ASHRAE requirements when tested in accordance with AHRI 210/240 and UL 1995.

#### 1.4 SUBMITTALS

- A. Submit in accordance with specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Manufacturer's Literature and Data.
  - 1. Air-Source Unitary Heat pump:
    - a. Packaged units
    - b. Split system
- C. Certification: Submit, simultaneously with shop drawings, a proof of certification that this product has been certified by AHRI.
- D. Performance Rating: Submit catalog selection data showing equipment ratings and compliance with required cooling and heating capacities EER and COP values as applicable.

#### 1.5 APPLICABLE PUBLICATIONS:

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Federal Specification (Fed. Spec.):
  - A-A-50502-90.....Air-conditioner (UNITARY HEAT PUMP), AIR TO AIR (3000 TO 300,000 BTUH)
- C. Air-Conditioning Heating and Refrigeration Institute (AHRI) Standards:
  - AHRI-DCPP .....Directory of Certified Product Performance - Applied Directory of Certified Products
  - 210/240-08.....Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment
  - 270-08.....Sound Rating of Outdoor Unitary Equipment
  - 310/380-04.....Standard for Packaged Terminal Air-Conditioners and Heat Pumps (CSA-C744-04)
  - 340/360-07.....Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment
- D. Air Movement and Control Association (AMCA):
  - 210-07 .....Laboratory Methods of Testing Fans for Aerodynamic Performance Rating (ANSI)
  - 410-96.....Recommended Safety Practices for Users and Installers of Industrial and Commercial Fans
- E. American National Standards Institute (ANSI):
  - S12.51-02 (R2007) .....Acoustics - Determination of Sound Power Levels of Noise Sources Using Sound Pressure - Precision Method for Reverberation Rooms (same as ISO 3741:1999)
- F. American Society of Heating, Refrigerating and Air-Conditioning Engineers Inc (ASHRAE):

- 15-10 ..... Safety Standard for Refrigeration Systems (ANSI)
- 62.1-10 ..... Ventilation for Acceptable Indoor Air Quality (ANSI)
- 90.1-07 ..... Energy Standard for Buildings except Low-Rise Residential  
Buildings
- 2008 Handbook.....HVAC Systems and Equipment
- G. American Society of Testing and Materials (ASTM):
  - B117-09..... Standard Practice for Operating Salt Spray (Fog) Apparatus
- H. National Electrical Manufacturer's Association (NEMA):
  - MG 1-09 (R2010) ..... Motors and Generators (ANSI)
  - ICS 1-00 (R2005) ..... Industrial Controls and Systems: General Requirements
- I. National Fire Protection Association (NFPA):
  - 90A-09..... Standard for the Installation of Air-Conditioning and Ventilating  
Systems
- J. Underwriters Laboratory (UL):
  - 1995-05 ..... Heating and Cooling Equipment

## **PART II- PRODUCTS**

### **2.1 UNITARY HEAT PUMPS, AIR TO AIR**

- A. Units shall comply with Fed Spec A-A-50502 Type II, (Split System) having remote outdoor section separate from indoor Section, Class 1, "Department of Energy" (DOE) covered products (units with cooling capacity up to 65000 Btu/hr.
  - 1. Unitary heat pumps shall bear the United States Environmental Protection Agency, Energy Star label and shall have a minimum Heating Season Performance Factor (HSPF) of 8.2 (Type II – Split System), and a minimum Seasonal Energy Efficiency Ratio (SEER) of 14.5 (Type II – Split System).
- B. Applicable AHRI Standards: Units shall be listed in the corresponding ARI Directory of Certified products shown in paragraph, APPLICABLE PUBLICATIONS:
  - 1. Air Source Unitary heat pumps with capacity less than 19 KW (65,000 Btu/hr), Comply with AHRI 210/240.
  - 2. Air Source heat pump with capacity above 19KW (above 65,000 Btu/hr, Comply with AHRI 340/360.
- C. Casing: Unit shall be constructed of zinc coated, 14-gage minimum galvanized steel. Exterior surfaces shall be cleaned, phosphatized, and finished with a weather-resistant baked enamel finish. Unit surfaces shall be tested 500 hours in a salt spray test in compliance with ASTM B117. Cabinet panels shall have lifting handles and shall be water- and air-tight seal. All exposed vertical, top covers and base pan shall be insulated with 25-mm (1-inch) matt-faced, fire-resistant, odorless, glass fiber material. Surfaces in contact with the airstream shall comply with



requirements in ASHRAE 62.1-2010. The base of the unit shall have provisions for forklift and crane lifting.

- D. Filters: One inch, MERV 7, throwaway filter shall be standard on all units below 19kW (6 Tons). Filter rack can be converted to two inch capability. Two inch, MERV 8, throwaway filters shall be factory supplied on all units above 19 kW (6 Tons).
- E. Compressors: Compressors shall be direct-drive, hermetic scroll type with centrifugal type oil pumps. Motor shall be suction gas-cooled. Internal overloads and crankcase heaters shall be utilized with all compressors.
- F. Refrigerant Circuit: A minimum of two circuits is required. Each refrigerant circuit shall have independent fixed orifice or thermostatic expansion devices, service pressure ports, and refrigerant line filter driers factory installed as standard. An area shall be provided for replacement suction line driers.
- G. Evaporator and Condenser Coils: Internally finned, DN 10 (NPS 3/8) copper tubes mechanically bonded to a configured aluminum plate fin shall be standard. The evaporator coil and condenser coil shall be leak tested at the factory to 1378 kPa (200 psig) and pressure tested to 2756 kPa (400 psig). All dual compressor units shall have intermingled evaporator coils. Sloped condensate drain pans shall be provided.
- H. Outdoor fans: Direct driven, statically and dynamically balanced, draw-through in the vertical discharge position. The fan motors shall be permanently lubricated and shall have built-in thermal overload protection.
- I. Indoor Fan:
  - 1. Forward-Curved, Centrifugal Fan: Provide V-belt driven with adjustable motor sheaves. Motors shall be thermally protected. Provide oversized motors for high static application. Motors shall meet the U.S. Energy Policy Act of 2005 (EPACT).
- J. Defrost Controls: A time initiated, temperature terminated defrost system shall ship with a setting of 70-minute cycle, with a choice of 50- or 90-minute cycle. Timed override limits defrost cycle to 10 minutes shall be available on units from 35- to 70-kW (10 to 20 tons). Adaptive demand defrost shall be provided on units below 35 kW (10 Tons).
- K. Unit Electrical
  - 1. Provide single point unit power connection.
  - 2. Unit control box shall be located within the unit and shall contain controls for compressor, reversing valve and fan motor operation and shall have a 50 VA 24-volt control circuit transformer and a terminal block for low voltage field wiring connections.
  - 3. Safety Controls - High pressure, low temperature, and low pressure safety switches shall be wired through a latching lockout circuit to hold the conditioner off until it is reset electrically by interrupting the power supply to the conditioner. All safety switches shall be normally closed, opening upon fault detection.

L. Operating Controls

1. Provide unit with low voltage electric controls
2. Low voltage, adjustable room thermostat to control heating and cooling in sequence with delay between stages, compressor and supply fan to maintain temperature setting. Include system selector switch off-heat-auto-cool and fan control switch (auto-on).

M. Accessories:

1. Electric Heater: Constructed of heavy-duty nickel chromium elements. Staging shall be achieved through the unit control processor. Each heater shall have automatically reset high limit control. Heaters shall be individually fused from the factory and shall comply with NEC and CEC requirements. Power assemblies shall provide single point connection. Electric heat modules shall be listed and labeled by a national recognized testing laboratory acceptable to authorities having jurisdiction. Electric heater controls shall confirm the supply fan is operating before electric elements are energized. Operate electric heater in 2 stages when outdoor ambient is too low to maintain space thermostat setting with compressor operation.
2. Economizer: Horizontal flow; factory installed; and shall include fully modulating 0-100 percent motor and dampers, barometric relief, minimum position setting and fixed dry bulb.
3. Oversized Motors: Factory installed over sized motor shall be available for high-static application.

## **2.2 CORROSION PROTECTION**

A. Remote Outdoor Condenser Coils:

1. Epoxy Immersion Coating – Electrically Deposited: The multi-stage corrosion-resistant coating application comprises of cleaning (heated alkaline immersion bath) and reverse-osmosis immersion rinse prior to the start of the coating process. The coating thickness shall be maintained between 0.6-mil and 1.2-mil. Before the coils are subjected to high-temperature oven cure, they are treated to permeate immersion rinse and spray. Where the coils are subject to UV exposure, UV protection spray treatment comprising of UV-resistant urethane mastic topcoat shall be applied. Provide complete coating process traceability for each coil and minimum five years of limited warranty. The coating process shall be such that uniform coating thickness is maintained at the fin edges. The quality control shall be maintained by ensuring compliance to the applicable ASTM Standards for the following:
  - a. Salt Spray Resistance (Minimum 6,000 Hours)
  - b. Humidity Resistance (Minimum 1,000 Hours)
  - c. Water Immersion (Minimum 260 Hours)
  - d. Cross-Hatch Adhesion (Minimum 4B-5B Rating)
  - e. Impact Resistance (Up to 160 Inch/Pound)

B. Exposed Outdoor Cabinet:

1. Casing Surfaces (Exterior and Interior): All exposed and accessible metal surfaces shall be protected with a water-reducible acrylic with stainless steel pigment spray-applied over the manufacturer's standard finish. The spray coating thickness shall be 2-4 mils and provide minimum salt-spray resistance of 1,000 hours (ASTM B117) AND 500 hours UV resistance (ASTM D4587).

## **PART 3- EXECUTION**

### **3.1 INSTALLATION**

- A. Install heat pumps according to manufacturers printed instructions.
- B. Install electrical and control devices furnished by the manufacturer but not specified to be factory mounted. All electrical work shall comply with Division 26 Sections.
- C. Piping: Comply with requirements in Section 23 23 00, REFRIGERANT PIPING.

### **3.2 STARTUP AND TESTING:**

- A. Perform startup checks according to manufacturer's written instructions.
- B. Test controls and demonstrate its compliance with project requirements. Replace damaged or malfunctioning controls and equipment and retest the equipment to the satisfaction of the Resident Engineer.
- C. Furnish test reports to the Senior Resident Engineer in accordance with specification Section 01 00 00, GENERAL REQUIREMENTS.

### **3.3 INSTRUCTIONS**

Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of heat pumps.

### **3.4 NOT USED**

### **3.5 NOT USED**

### **3.6 DEMONSTRATION AND TRAINING**

- A. Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of units.
- B. Submit training plans and instructor qualifications.

--- E N D ---

**SECTION 26 05 11**  
**REQUIREMENTS FOR ELECTRICAL INSTALLATIONS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section applies to all sections of Division 26.
- B. Furnish and install electrical systems, materials, equipment, and accessories in accordance with the specifications and drawings. Capacities and ratings of motors, transformers, conductors and cable, switchboards, switchgear, panelboards, motor control centers, generators, automatic transfer switches, and other items and arrangements for the specified items are shown on the drawings.
- C. Conductor ampacities specified or shown on the drawings are based on copper conductors, with the conduit and raceways sized per NEC. Aluminum conductors are prohibited.

**1.2 MINIMUM REQUIREMENTS**

- A. The latest International Building Code (IBC), Underwriters Laboratories, Inc. (UL), Institute of Electrical and Electronics Engineers (IEEE), and National Fire Protection Association (NFPA) codes and standards are the minimum requirements for materials and installation.
- B. The drawings and specifications shall govern in those instances where requirements are greater than those stated in the above codes and standards.

**1.3 TEST STANDARDS**

- A. All materials and equipment shall be listed, labeled, or certified by a Nationally Recognized Testing Laboratory (NRTL) to meet Underwriters Laboratories, Inc. (UL), standards where test standards have been established. Materials and equipment which are not covered by UL standards will be accepted, providing that materials and equipment are listed, labeled, certified or otherwise determined to meet the safety requirements of a NRTL. Materials and equipment which no NRTL accepts, certifies, lists, labels, or determines to be safe, will be considered if inspected or tested in accordance with national industrial standards, such as ANSI, NEMA, and NETA. Evidence of compliance shall include certified test reports and definitive shop drawings.
- B. Definitions:
  - 1. Listed: Materials and equipment included in a list published by an organization that is acceptable to the Authority Having Jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production or listed materials and equipment or periodic evaluation of services, and whose listing states that the materials and equipment either meets appropriate designated standards or has been tested and found suitable for a specified purpose.
  - 2. Labeled: Materials and equipment to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the Authority Having Jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled

materials and equipment, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

3. Certified: Materials and equipment which:
  - a. Have been tested and found by a NRTL to meet nationally recognized standards or to be safe for use in a specified manner.
  - b. Are periodically inspected by a NRTL.
  - c. Bear a label, tag, or other record of certification.
4. Nationally Recognized Testing Laboratory: Testing laboratory which is recognized and approved by the Secretary of Labor in accordance with OSHA regulations.

#### **1.4 QUALIFICATIONS (PRODUCTS AND SERVICES)**

- A. Manufacturer's Qualifications: The manufacturer shall regularly and currently produce, as one of the manufacturer's principal products, the materials and equipment specified for this project, and shall have manufactured the materials and equipment for at least three years.
- B. Product Qualification:
  1. Manufacturer's materials and equipment shall have been in satisfactory operation, on three installations of similar size and type as this project, for at least three years.
  2. The Government reserves the right to require the Contractor to submit a list of installations where the materials and equipment have been in operation before approval.
- C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four hours of receipt of notification that service is needed. Submit name and address of service organizations.

#### **1.5 APPLICABLE PUBLICATIONS**

- A. Applicable publications listed in all Sections of Division 26 shall be the latest issue, unless otherwise noted.
- B. Products specified in all sections of Division 26 shall comply with the applicable publications listed in each section.

#### **1.6 MANUFACTURED PRODUCTS**

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, and for which replacement parts shall be available. Materials and equipment furnished shall be new, and shall have superior quality and freshness.
- B. When more than one unit of the same class or type of materials and equipment is required, such units shall be the product of a single manufacturer.
- C. Equipment Assemblies and Components:
  1. Components of an assembled unit need not be products of the same manufacturer.
  2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.

3. Components shall be compatible with each other and with the total assembly for the intended service.
4. Constituent parts which are similar shall be the product of a single manufacturer.
- D. Factory wiring and terminals shall be identified on the equipment being furnished and on all wiring diagrams.
- E. When Factory Tests are specified, Factory Tests shall be performed in the factory by the equipment manufacturer, and witnessed by the contractor. In addition, the following requirements shall be complied with:
  1. The Government shall have the option of witnessing factory tests. The Contractor shall notify the Government through the COR a minimum of thirty (30) days prior to the manufacturer's performing of the factory tests.
  2. When factory tests are successful, contractor shall furnish four (4) copies of the equipment manufacturer's certified test reports to the COR fourteen (14) days prior to shipment of the equipment, and not more than ninety (90) days after completion of the factory tests.
  3. When factory tests are not successful, factory tests shall be repeated in the factory by the equipment manufacturer, and witnessed by the Contractor. The Contractor shall be liable for all additional expenses for the Government to witness factory re-testing.

#### **1.7 VARIATIONS FROM CONTRACT REQUIREMENTS**

- A. Where the Government or the Contractor requests variations from the contract requirements, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

#### **1.8 MATERIALS AND EQUIPMENT PROTECTION**

- A. Materials and equipment shall be protected during shipment and storage against physical damage, vermin, dirt, corrosive substances, fumes, moisture, cold and rain.
  1. Store materials and equipment indoors in clean dry space with uniform temperature to prevent condensation.
  2. During installation, equipment shall be protected against entry of foreign matter, and be vacuum-cleaned both inside and outside before testing and operating. Compressed air shall not be used to clean equipment. Remove loose packing and flammable materials from inside equipment.
  3. Damaged equipment shall be repaired or replaced, as determined by the COR.
  4. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
  5. Damaged paint on equipment shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

### 1.9 WORK PERFORMANCE

- A. All electrical work shall comply with requirements of the latest NFPA 70 (NEC), NFPA 70B, NFPA 70E, NFPA 99, NFPA 110, OSHA Part 1910 subpart J – General Environmental Controls, OSHA Part 1910 subpart K – Medical and First Aid, and OSHA Part 1910 subpart S – Electrical, in addition to other references required by contract.
- B. Job site safety and worker safety is the responsibility of the Contractor.
- C. Electrical work shall be accomplished with all affected circuits or equipment de-energized. However, energized electrical work may be performed only for the non-destructive and non-invasive diagnostic testing(s), or when scheduled outage poses an imminent hazard to patient care, safety, or physical security. In such case, all aspects of energized electrical work, such as the availability of appropriate/correct personal protective equipment (PPE) and the use of PPE, shall comply with the latest NFPA 70E, as well as the following requirements:
  - 1. Only Qualified Person(s) shall perform energized electrical work. Supervisor of Qualified Person(s) shall witness the work of its entirety to ensure compliance with safety requirements and approved work plan.
  - 2. At least two weeks before initiating any energized electrical work, the Contractor and the Qualified Person(s) who is designated to perform the work shall visually inspect, verify and confirm that the work area and electrical equipment can safely accommodate the work involved.
  - 3. At least two weeks before initiating any energized electrical work, the Contractor shall develop and submit a job specific work plan, and energized electrical work request to the COR, and Medical Center's Chief Engineer or his/her designee. At the minimum, the work plan must include relevant information such as proposed work schedule, area of work, description of work, name(s) of Supervisor and Qualified Person(s) performing the work, equipment to be used, procedures to be used on and near the live electrical equipment, barriers to be installed, safety equipment to be used, and exit pathways.
  - 4. Energized electrical work shall begin only after the Contractor has obtained written approval of the work plan, and the energized electrical work request from the COR, and Medical Center's Chief Engineer or his/her designee. The Contractor shall make these approved documents present and available at the time and place of energized electrical work.
  - 5. Energized electrical work shall begin only after the Contractor has invited and received acknowledgment from the COR, and Medical Center's Chief Engineer or his/her designee to witness the work.
- D. For work that affects existing electrical systems, arrange, phase and perform work to assure minimal interference with normal functioning of the facility. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.

- E. New work shall be installed and connected to existing work neatly, safely and professionally. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.
- F. Coordinate location of equipment and conduit with other trades to minimize interference.

#### **1.10 EQUIPMENT INSTALLATION AND REQUIREMENTS**

- A. Equipment location shall be as close as practical to locations shown on the drawings.
- B. Working clearances shall not be less than specified in the NEC.
- C. Inaccessible Equipment:
  - 1. Where the Government determines that the Contractor has installed equipment not readily accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.
  - 2. "Readily accessible" is defined as being capable of being reached quickly for operation, maintenance, or inspections without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

#### **1.11 EQUIPMENT IDENTIFICATION**

- A. In addition to the requirements of the NEC, install an identification sign which clearly indicates information required for use and maintenance of items such as switchboards and switchgear, panelboards, cabinets, motor controllers, fused and non-fused safety switches, generators, automatic transfer switches, separately enclosed circuit breakers, individual breakers and controllers in switchboards, switchgear and motor control assemblies, control devices and other significant equipment.
- B. Identification signs for Normal Power System equipment shall be laminated black phenolic resin with a white core with engraved lettering. Identification signs for Essential Electrical System (EES) equipment, as defined in the NEC, shall be laminated red phenolic resin with a white core with engraved lettering. Lettering shall be a minimum of 12 mm (1/2 inch) high. Identification signs shall indicate equipment designation, rated bus amperage, voltage, number of phases, number of wires, wire size and type of EES power branch as applicable. Secure nameplates with screws.
- C. Install adhesive arc flash warning labels on all equipment as required by the latest NFPA 70E. Label shall show specific and correct information for specific equipment based on its arc flash calculations. Label shall show the followings:
  - 1. Nominal system voltage.
  - 2. Equipment/bus name, date prepared, and manufacturer name and address.
  - 3. Arc flash boundary.
  - 4. Available arc flash incident energy and the corresponding working distance.
  - 5. Minimum arc rating of clothing.



6. Site-specific level of PPE.

#### **1.12 SUBMITTALS**

- A. Submit to the COR in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. The Government's approval shall be obtained for all materials and equipment before delivery to the job site. Delivery, storage or installation of materials and equipment which has not had prior approval will not be permitted.
- C. All submittals shall include six copies of adequate descriptive literature, catalog cuts, shop drawings, test reports, certifications, samples, and other data necessary for the Government to ascertain that the proposed materials and equipment comply with drawing and specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify specific materials and equipment being submitted.
- D. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.
  - 1. Mark the submittals, "SUBMITTED UNDER SECTION\_\_\_\_\_".
  - 2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
  - 3. Submit each section separately.
- E. The submittals shall include the following:
  - 1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, manuals, pictures, nameplate data, and test reports as required.
  - 2. Submittals are required for all equipment anchors and supports. Submittals shall include weights, dimensions, center of gravity, standard connections, manufacturer's recommendations and behavior problems (e.g., vibration, thermal expansion, etc.) associated with equipment or piping so that the proposed installation can be properly reviewed. Include sufficient fabrication information so that appropriate mounting and securing provisions may be designed and attached to the equipment.
  - 3. Elementary and interconnection wiring diagrams for communication and signal systems, control systems, and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
  - 4. Parts list which shall include information for replacement parts and ordering instructions, as recommended by the equipment manufacturer.
- F. Maintenance and Operation Manuals:
  - 1. Submit as required for systems and equipment specified in the technical sections. Furnish in hardcover binders or an approved equivalent.

2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, material, equipment, building, name of Contractor, and contract name and number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the material or equipment.
3. Provide a table of contents and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.
4. The manuals shall include:
  - a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
  - b. A control sequence describing start-up, operation, and shutdown.
  - c. Description of the function of each principal item of equipment.
  - d. Installation instructions.
  - e. Safety precautions for operation and maintenance.
  - f. Diagrams and illustrations.
  - g. Periodic maintenance and testing procedures and frequencies, including replacement parts numbers.
  - h. Performance data.
  - i. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare and replacement parts, and name of servicing organization.
  - j. List of factory approved or qualified permanent servicing organizations for equipment repair and periodic testing and maintenance, including addresses and factory certification qualifications.
- G. Approvals will be based on complete submission of shop drawings, manuals, test reports, certifications, and samples as applicable.
- H. After approval and prior to installation, furnish the COR with one sample of each of the following:
  1. A minimum 300 mm (12 inches) length of each type and size of wire and cable along with the tag from the coils or reels from which the sample was taken. The length of the sample shall be sufficient to show all markings provided by the manufacturer.
  2. Each type of conduit coupling, bushing, and termination fitting.
  3. Conduit hangers, clamps, and supports.
  4. Duct sealing compound.
  5. Each type of receptacle, toggle switch, lighting control sensor, outlet box, manual motor starter, device wall plate, engraved nameplate, wire and cable splicing and terminating material, and branch circuit single pole molded case circuit breaker.

### **1.13 SINGULAR NUMBER**

- A. Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

### **1.14 ACCEPTANCE CHECKS AND TESTS**

- A. The Contractor shall furnish the instruments, materials, and labor for tests.
- B. Where systems are comprised of components specified in more than one section of Division 26, the Contractor shall coordinate the installation, testing, and adjustment of all components between various manufacturer's representatives and technicians so that a complete, functional, and operational system is delivered to the Government.
- C. When test results indicate any defects, the Contractor shall repair or replace the defective materials or equipment, and repeat the tests for the equipment. Repair, replacement, and re-testing shall be accomplished at no additional cost to the Government.

### **1.15 WARRANTY**

- A. All work performed and all equipment and material furnished under this Division shall be free from defects and shall remain so for a period of one year from the date of acceptance of the entire installation by the Contracting Officer for the Government.

### **1.16 INSTRUCTION**

- A. Instruction to designated Government personnel shall be provided for the particular equipment or system as required in each associated technical specification section.
- B. Furnish the services of competent and factory-trained instructors to give full instruction in the adjustment, operation, and maintenance of the specified equipment and system, including pertinent safety requirements. Instructors shall be thoroughly familiar with all aspects of the installation, and shall be factory-trained in operating theory as well as practical operation and maintenance procedures.
- C. A training schedule shall be developed and submitted by the Contractor and approved by the COR at least 30 days prior to the planned training.

### **1.17 DRAWINGS AND SPECIFICATIONS**

- A. The drawings indicate the general arrangement of the work and are to be followed insofar as possible. The word "provide", as used, shall mean "furnish and install". If significant deviations from the layout are necessitated by field conditions, detailed layouts of the proposed departures shall be submitted to the COR for approval before proceeding with the work.
- B. Make all necessary field measurements to ensure correct fitting. Coordinate work with all other trades in such a manner as to cause a minimum of conflict or delay.
- C. The drawings and specifications shall be carefully studied during the course of bidding and construction. Any errors, omissions or discrepancies encountered shall be referred immediately to the COR for interpretation or correction, so that misunderstandings at a later date may be avoided.

The contract drawings are not intended to show every vertical or horizontal offset which may be necessary to complete the systems. Having bus duct, wireways and fittings fabricated and delivered in advance of making actual measurements shall not be sufficient cause to avoid making offsets and minor changes as may be necessary to install bus duct, wireways, fittings and equipment.

- D. The COR shall reserve the right to make minor adjustment in locations of system runs and components where he considers such adjustments desirable in the interest of protecting and concealing work or presenting a better appearance where exposed. Any such changes shall be anticipated and requested sufficiently in advance as to not cause extra work, or unduly delay the work. Coordinate work in advance with all other trades and report immediately any difficulties which can be anticipated.
- E. Equipment, ductwork and piping shall not be installed in the dedicated electrical space above or in the working space required around electrical switchgear, motor control centers or panelboards as identified by NEC 110.26 Spaces About Electrical Equipment – 600 Volts Nominal or Less. For equipment rated over 600 volts nominal – 110.32 Work Space About Equipment – 110.33 Entrance and Access to Work Space – 110.34 Work Space and Guarding. The Electrical Contractor shall caution other trades to comply with this stipulation.
- F. Where any system runs and components are so placed as to cause or contribute to a conflict, it shall be readjusted at the expense of the contractor causing such conflict. The COR's decision shall be final in regard to the arrangement of bus duct, conduit, etc., where conflict arises.
- G. Provide offsets in system runs, additional fittings, necessary conduit, pull boxes, conductors, switches and devices required to complete the installation, or for the proper operation of the system. Each Contractor shall exercise due and particular caution to determine that all parts of the work are made quickly and easily accessible.
- H. Should overlap of work among the trades become evident, this shall be called to the attention of the COR. In such event, none of the trades or their suppliers shall assume that he is relieved of the work which is specified under his branch until instructions in writing are received from the COR.

#### **1.18 RECORD DRAWINGS**

- A. The Electrical Contractor shall maintain a separate set of prints of the contract documents and shall show all changes or variations, in a manner to be clearly discernible, which are made during construction. Upon completion of the work, these drawings shall be turned over to the Architect. This shall apply particularly to underground and concealed work, and to other systems where the installation varies to a degree which would justify recording the change.

#### **1.19 FINAL INSPECTION AND PUNCH LIST**

- A. As the time of work completion approaches, the Contractor shall survey and inspect his work and develop his own punch list to confirm that it is complete and finished. He shall then notify the COR and request that a final inspection be made. It shall not be considered the COR's obligation to

perform a final inspection until the Contractor has inspected the work and so states at the time of the request for the final inspection.

- B. Requests to the COR for final inspection may be accompanied by a limited list of known deficiencies in completion, with appropriate explanation and schedule for completing these; this is in the interest of expediting acceptance for beneficial occupancy.
- C. The Architect and/or Engineer will inspect the work and prepare a punch list of items requiring correction, completion or verification. Corrective action shall be taken by the Contractor to the satisfaction of Architect and Engineer within 30 days of receipt of the Architect/Engineer's punch list.

#### **1.20 REMOVALS**

- A. Remove ALL existing work which will be superfluous when the new system is installed and made operational. Not all items that need to be removed are necessarily shown on the drawings. Void unused conduit behind walls or below floors as necessary or as directed. No wire or conduit shall be removed which will impair the functioning of the remaining work unless first replaced with a rerouted section of wire or conduit to ensure continuity. Remove inactive wiring back to the last active junction box, panelboard or piece of equipment.
- B. Upon completion, no unused conduit or stub shall extend thru floors, walls or ceilings in finished areas. Abandoned conduit where remaining in place shall have any unused wiring removed. All accessible unused conduit shall be removed.
- C. When it is necessary to reroute a section of an active circuit, the rerouted section shall be installed before removing the existing in order to minimize system down time. Rerouted sections shall be installed as required for new work.
- D. Division 26 contractor shall be responsible for removing all existing backboxes not maintained for new work. Patch and repair all existing drywall associated with removal work to match existing conditions.

#### **PART 2 - PRODUCTS (NOT USED)**

#### **PART 3 - EXECUTION (NOT USED)**

---END---

**SECTION 26 05 19**  
**LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation, connection, and testing of the electrical conductors and cables for use in electrical systems rated 600 V and below, indicated as cable(s), conductor(s), wire, or wiring in this section.

**1.2 RELATED WORK**

- A. Section 07 84 00, FIRESTOPPING: Sealing around penetrations to maintain the integrity of fire-resistant rated construction.
- B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits for conductors and cables.

**1.3 QUALITY ASSURANCE**

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 FACTORY TESTS**

- A. Conductors and cables shall be thoroughly tested at the factory per NEMA to ensure that there are no electrical defects. Factory tests shall be certified.

**1.5 SUBMITTALS**

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
  - 1. Shop Drawings:
    - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
    - b. Submit the following data for approval:
      - 1) Electrical ratings and insulation type for each conductor and cable.
      - 2) Splicing materials and pulling lubricant.
  - 2. Certifications: Two weeks prior to final inspection, submit the following.
    - a. Certification by the manufacturer that the conductors and cables conform to the requirements of the drawings and specifications.
    - b. Certification by the Contractor that the conductors and cables have been properly installed, adjusted, and tested.

## 1.6 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are reference in the text by designation only.
- B. American Society of Testing Material (ASTM):
  - D2301-10 ..... Standard Specification for Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape
  - D2304-10 ..... Test Method for Thermal Endurance of Rigid Electrical Insulating Materials
  - D3005-10 ..... Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape
- C. National Electrical Manufacturers Association (NEMA):
  - WC 70-09 ..... Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy
- D. National Fire Protection Association (NFPA):
  - 70-14 ..... National Electrical Code (NEC)
- E. Underwriters Laboratories, Inc. (UL):
  - 44-10 ..... Thermoset-Insulated Wires and Cables
  - 83-08 ..... Thermoplastic-Insulated Wires and Cables
  - 467-07 ..... Grounding and Bonding Equipment
  - 486A-486B-03 ..... Wire Connectors
  - 486C-04 ..... Splicing Wire Connectors
  - 486D-05 ..... Sealed Wire Connector Systems
  - 486E-09 ..... Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
  - 493-07 ..... Thermoplastic-Insulated Underground Feeder and Branch Circuit Cables
  - 514B-04 ..... Conduit, Tubing, and Cable Fittings

## PART 2 - PRODUCTS

### 2.1 CONDUCTORS AND CABLES

- A. Conductors and cables shall be in accordance with NEMA, UL, as specified herein, and as shown on the drawings.
- B. All conductors shall be copper.
- C. Single Conductor and Cable:
  - 1. No. 12 AWG: Minimum size, except where smaller sizes are specified herein or shown on the drawings.
  - 2. No. 8 AWG and larger: Stranded.

3. No. 10 AWG and smaller: Solid; except shall be stranded for final connection to motors, transformers, and vibrating equipment.
4. Insulation: THHN-THWN and XHHW-2.

D. Color Code:

1. No. 10 AWG and smaller: Solid color insulation or solid color coating.
2. No. 8 AWG and larger: Color-coded using one of the following methods:
  - a. Solid color insulation or solid color coating.
  - b. Stripes, bands, or hash marks of color specified.
  - c. Color using 19 mm (0.75 inches) wide tape.
4. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.
5. Conductors shall be color-coded as follows:

208/120 V	Phase	480/277 V
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray *
* or white with colored (other than green) tracer.		

6. Lighting circuit "switch legs", and 3-way and 4-way switch "traveling wires," shall have color coding that is unique and distinct (e.g., pink and purple) from the color coding indicated above. The unique color codes shall be solid and in accordance with the NEC. Coordinate color coding in the field with the COR.
7. Color code for isolated power system wiring shall be in accordance with the NEC.

## 2.2 SPLICES

- A. Splices shall be in accordance with NEC and UL.
- B. Above Ground Splices for No. 10 AWG and Smaller:
  1. Solderless, screw-on, reusable pressure cable type, with integral insulation, approved for copper and aluminum conductors.
  2. The integral insulator shall have a skirt to completely cover the stripped conductors.
  3. The number, size, and combination of conductors used with the connector, as listed on the manufacturer's packaging, shall be strictly followed.
- C. Above Ground Splices for No. 8 AWG to No. 4/0 AWG:
  1. Compression, hex screw, or bolt clamp-type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
  2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.



3. Splice and insulation shall be product of the same manufacturer.
  4. All bolts, nuts, and washers used with splices shall be cadmium-plated steel.
- D. Above Ground Splices for 250 kcmil and Larger:
1. Long barrel "butt-splice" or "sleeve" type compression connectors, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.
  2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
  3. Splice and insulation shall be product of the same manufacturer.
- E. Underground Splices for No. 10 AWG and Smaller:
1. Solderless, screw-on, reusable pressure cable type, with integral insulation. Listed for wet locations, and approved for copper and aluminum conductors.
  2. The integral insulator shall have a skirt to completely cover the stripped conductors.
  3. The number, size, and combination of conductors used with the connector, as listed on the manufacturer's packaging, shall be strictly followed.
- F. Underground Splices for No. 8 AWG and Larger:
1. Mechanical type, of high conductivity and corrosion-resistant material. Listed for wet locations, and approved for copper and aluminum conductors.
  2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
  3. Splice and insulation shall be product of the same manufacturer.
- G. Plastic electrical insulating tape: Per ASTM D2304, flame-retardant, cold and weather resistant.

## **2.3 CONNECTORS AND TERMINATIONS**

- A. Mechanical type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
- B. Long barrel compression type of high conductivity and corrosion-resistant material, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.
- C. All bolts, nuts, and washers used to connect connections and terminations to bus bars or other termination points shall be cadmium-plated steel.

## **2.4 CONTROL WIRING**

- A. Unless otherwise specified elsewhere in these specifications, control wiring shall be as specified herein, except that the minimum size shall be not less than No. 14 AWG.
- B. Control wiring shall be sized such that the voltage drop under in-rush conditions does not adversely affect operation of the controls.

## **2.5 WIRE LUBRICATING COMPOUND**

- A. Lubricating compound shall be suitable for the wire insulation and conduit, and shall not harden or become adhesive.
- B. Shall not be used on conductors for isolated power systems.

### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- A. Install conductors in accordance with the NEC, as specified, and as shown on the drawings.
- B. Install all conductors in raceway systems.
- C. Splice conductors only in outlet boxes, junction boxes, pullboxes, manholes, or handholes.
- D. Conductors of different systems (e.g., 120 V and 277 V) shall not be installed in the same raceway.
- E. Install cable supports for all vertical feeders in accordance with the NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.
- F. In panelboards, cabinets, wireways, switches, enclosures, and equipment assemblies, neatly form, train, and tie the conductors with non-metallic ties.
- G. For connections to motors, transformers, and vibrating equipment, stranded conductors shall be used only from the last fixed point of connection to the motors, transformers, or vibrating equipment.
- H. Use expanding foam or non-hardening duct-seal to seal conduits entering a building, after installation of conductors.
- I. Conductor and Cable Pulling:
  - 1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling. Use lubricants approved for the cable.
  - 2. Use nonmetallic pull ropes.
  - 3. Attach pull ropes by means of either woven basket grips or pulling eyes attached directly to the conductors.
  - 4. All conductors in a single conduit shall be pulled simultaneously.
  - 5. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- J. No more than three branch circuits shall be installed in any one conduit.
- K. When stripping stranded conductors, use a tool that does not damage the conductor or remove conductor strands.

#### **3.2 INSTALLATION IN MANHOLES**

- A. Train the cables around the manhole walls, but do not bend to a radius less than six times the overall cable diameter.
- B. Fireproofing:
  - 1. Install fireproofing on low-voltage conductors where the low-voltage conductors are installed in the same manholes with medium-voltage conductors.
  - 2. Secure the fireproofing tape in place by a random wrap of glass cloth tape.

### **3.3 SPLICE AND TERMINATION INSTALLATION**

- A. Splices and terminations shall be mechanically and electrically secure, and tightened to manufacturer's published torque values using a torque screwdriver or wrench.
- B. Where the Government determines that unsatisfactory splices or terminations have been installed, replace the splices or terminations at no additional cost to the Government.

### **3.4 CONDUCTOR IDENTIFICATION**

- A. When using colored tape to identify phase, neutral, and ground conductors larger than No. 8 AWG, apply tape in half-overlapping turns for a minimum of 75 mm (3 inches) from terminal points, and in junction boxes, pullboxes, and manholes. Apply the last two laps of tape with no tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable, stating size and insulation type.

### **3.5 FEEDER CONDUCTOR IDENTIFICATION**

- A. In each interior pullbox and each underground manhole and handhole, install brass tags on all feeder conductors to clearly designate their circuit identification and voltage. The tags shall be the embossed type, 40 mm (1-1/2 inches) in diameter and 40 mils thick. Attach tags with plastic ties.

### **3.6 EXISTING CONDUCTORS**

- A. Unless specifically indicated on the plans, existing conductors shall not be reused.

### **3.7 CONTROL WIRING INSTALLATION**

- A. Unless otherwise specified in other sections, install control wiring and connect to equipment to perform the required functions as specified or as shown on the drawings.
- B. Install a separate power supply circuit for each system, except where otherwise shown on the drawings.

### **3.8 CONTROL WIRING IDENTIFICATION**

- A. Install a permanent wire marker on each wire at each termination.
- B. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.
- C. Wire markers shall retain their markings after cleaning.
- D. In each manhole and handhole, install embossed brass tags to identify the system served and function.

### **3.9 ACCEPTANCE CHECKS AND TESTS**

- A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:
  - 1. Visual Inspection and Tests: Inspect physical condition.
  - 2. Electrical tests:
    - a. After installation but before connection to utilization devices, such as fixtures, motors, or appliances, test conductors phase-to-phase and phase-to-ground resistance with an insulation resistance tester. Existing conductors to be reused shall also be tested.

- b. Applied voltage shall be 500 V DC for 300 V rated cable, and 1000 V DC for 600 V rated cable. Apply test for one minute or until reading is constant for 15 seconds, whichever is longer. Minimum insulation resistance values shall not be less than 25 megohms for 300 V rated cable and 100 megohms for 600 V rated cable.
- c. Perform phase rotation test on all three-phase circuits.

---END---

**SECTION 26 05 26**  
**GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation, connection, and testing of grounding and bonding equipment, indicated as grounding equipment in this section.
- B. "Grounding electrode system" refers to grounding electrode conductors and all electrodes required or allowed by NEC, as well as made, supplementary, and lightning protection system grounding electrodes.
- C. The terms "connect" and "bond" are used interchangeably in this section and have the same meaning.

**1.2 RELATED WORK**

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
- C. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit and boxes.

**1.3 QUALITY ASSURANCE**

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 SUBMITTALS**

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
  - 1. Shop Drawings:
    - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
    - b. Submit plans showing the location of system grounding electrodes and connections, and the routing of aboveground and underground grounding electrode conductors.
  - 2. Test Reports:
    - a. Two weeks prior to the final inspection, submit ground resistance field test reports to the COR.
  - 3. Certifications:
    - a. Certification by the Contractor that the grounding equipment has been properly installed and tested.

## 1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. American Society for Testing and Materials (ASTM):
  - B1-07 ..... Standard Specification for Hard-Drawn Copper Wire
  - B3-07 ..... Standard Specification for Soft or Annealed Copper Wire
  - B8-11 ..... Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- C. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
  - 81-83 ..... IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System Part 1: Normal Measurements
- D. National Fire Protection Association (NFPA):
  - 70-14 ..... National Electrical Code (NEC)
  - 70E-12 ..... National Electrical Safety Code
  - 99-12 ..... Health Care Facilities
- E. Underwriters Laboratories, Inc. (UL):
  - 44-10 ..... Thermoset-Insulated Wires and Cables
  - 83-08 ..... Thermoplastic-Insulated Wires and Cables
  - 467-07 ..... Grounding and Bonding Equipment

## PART 2 - PRODUCTS

### 2.1 GROUNDING AND BONDING CONDUCTORS

- A. Equipment grounding conductors shall be insulated stranded copper, except that sizes No. 10 AWG and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes No. 4 AWG and larger shall be identified per NEC.
- B. Bonding conductors shall be bare stranded copper, except that sizes No. 10 AWG and smaller shall be bare solid copper. Bonding conductors shall be stranded for final connection to motors, transformers, and vibrating equipment.
- C. Conductor sizes shall not be less than shown on the drawings, or not less than required by the NEC, whichever is greater.
- D. Insulation: THHN-THWN and XHHW-2.

### 2.2 GROUND RODS

- A. Copper clad steel, 19 mm (0.75 inch) diameter by 3 M (10 feet) long.
- B. Quantity of rods shall be as shown on the drawings, and as required to obtain the specified ground resistance.

### **2.3 CONCRETE ENCASED ELECTRODE**

- A. Concrete encased electrode shall be No. 4 AWG bare copper wire, installed per NEC.

### **2.4 GROUND CONNECTIONS**

- A. Below Grade and Inaccessible Locations: Exothermic-welded type connectors.
- B. Above Grade:
  - 1. Bonding Jumpers: Listed for use with aluminum and copper conductors. For wire sizes No. 8 AWG and larger, use compression-type connectors. For wire sizes smaller than No. 8 AWG, use mechanical type lugs. Connectors or lugs shall use cadmium-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.
  - 2. Connection to Building Steel: Exothermic-welded type connectors.
  - 3. Connection to Grounding Bus Bars: Listed for use with aluminum and copper conductors. Use mechanical type lugs, with cadmium-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.
  - 4. Connection to Equipment Rack and Cabinet Ground Bars: Listed for use with aluminum and copper conductors. Use mechanical type lugs, with cadmium-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

### **2.5 EQUIPMENT RACK AND CABINET GROUND BARS**

- A. Provide solid copper ground bars designed for mounting on the framework of open or cabinet-enclosed equipment racks. Ground bars shall have minimum dimensions of 6.3 mm (0.25 inch) thick x 19 mm (0.75 inch) wide, with length as required or as shown on the drawings. Provide insulators and mounting brackets.

### **2.6 GROUND TERMINAL BLOCKS**

- A. At any equipment mounting location (e.g., backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide mechanical type lugs, with cadmium-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

### **2.7 GROUNDING BUS BAR**

- A. Pre-drilled rectangular copper bar with stand-off insulators, minimum 6.3 mm (0.25 inch) thick x 100 mm (4 inches) high in cross-section, length as shown on the drawings, with hole size, quantity, and spacing per detail shown on the drawings. Provide insulators and mounting brackets.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. Install grounding equipment in accordance with the NEC, as shown on the drawings, and as specified herein.
- B. System Grounding:
  - 1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformer.

2. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.
- C. Equipment Grounding: Metallic piping, building structural steel, electrical enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits, shall be bonded and grounded.
- D. For patient care area electrical power system grounding, conform to NFPA 99 and NEC.

### **3.2 INACCESSIBLE GROUNDING CONNECTIONS**

- A. Make grounding connections, which are normally buried or otherwise inaccessible, by exothermic weld.

### **3.3 SECONDARY VOLTAGE EQUIPMENT AND CIRCUITS**

- A. Main Bonding Jumper: Bond the secondary service neutral to the ground bus in the service equipment.
- B. Metallic Piping, Building Structural Steel, and Supplemental Electrode(s):
  1. Provide a grounding electrode conductor sized per NEC between the service equipment ground bus and all metallic water pipe systems, building structural steel, and supplemental or made electrodes. Provide jumpers across insulating joints in the metallic piping.
  2. Provide a supplemental ground electrode as shown on the drawings and bond to the grounding electrode system.
- C. Switchgear, Switchboards, Unit Substations, Panelboards, Motor Control Centers, Engine-Generators, Automatic Transfer Switches, and other electrical equipment:
  1. Connect the equipment grounding conductors to the ground bus.
  2. Connect metallic conduits by grounding bushings and equipment grounding conductor to the equipment ground bus.
- D. Transformers:
  1. Exterior: Exterior transformers supplying interior service equipment shall have the neutral grounded at the transformer secondary. Provide a grounding electrode at the transformer.
  2. Separately derived systems (transformers downstream from service equipment): Ground the secondary neutral at the transformer. Provide a grounding electrode conductor from the transformer to the ground bar at the service equipment.

### **3.4 RACEWAY**

- A. Conduit Systems:
  1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
  2. Non-metallic conduit systems, except non-metallic feeder conduits that carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment, shall contain an equipment grounding conductor.



3. Metallic conduit that only contains a grounding conductor, and is provided for its mechanical protection, shall be bonded to that conductor at the entrance and exit from the conduit.
  4. Metallic conduits which terminate without mechanical connection to an electrical equipment housing by means of locknut and bushings or adapters, shall be provided with grounding bushings. Connect bushings with a equipment grounding conductor to the equipment ground bus.
- B. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders, and power and lighting branch circuits.
- C. Boxes, Cabinets, Enclosures, and Panelboards:
1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (except for special grounding systems for intensive care units and other critical units shown).
  2. Provide lugs in each box and enclosure for equipment grounding conductor termination.
- D. Wireway Systems:
1. Bond the metallic structures of wireway to provide electrical continuity throughout the wireway system, by connecting a No. 6 AWG bonding jumper at all intermediate metallic enclosures and across all section junctions.
  2. Install insulated No. 6 AWG bonding jumpers between the wireway system, bonded as required above, and the closest building ground at each end and approximately every 16 M (50 feet).
  3. Use insulated No. 6 AWG bonding jumpers to ground or bond metallic wireway at each end for all intermediate metallic enclosures and across all section junctions.
  4. Use insulated No. 6 AWG bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 15 M (49 feet).
- E. Receptacles shall not be grounded through their mounting screws. Ground receptacles with a jumper from the receptacle green ground terminal to the device box ground screw and a jumper to the branch circuit equipment grounding conductor.
- F. Ground lighting fixtures to the equipment grounding conductor of the wiring system. Fixtures connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.
- G. Fixed electrical appliances and equipment shall be provided with a ground lug for termination of the equipment grounding conductor.
- H. Panelboard Bonding in Patient Care Areas: The equipment grounding terminal buses of the normal and essential branch circuit panel boards serving the same individual patient vicinity shall be bonded together with an insulated continuous copper conductor not less than No. 10 AWG, installed in rigid metal conduit.

### **3.5 CORROSION INHIBITORS**

- A. When making grounding and bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

### **3.6 CONDUCTIVE PIPING**

- A. Bond all conductive piping systems, interior and exterior, to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.
- B. In operating rooms and at intensive care and coronary care type beds, bond the medical gas piping and medical vacuum piping at the outlets directly to the patient ground bus.

### **3.7 LIGHTNING PROTECTION SYSTEM**

- A. Bond the lightning protection system to the electrical grounding electrode system.

### **3.8 GROUND RESISTANCE**

- A. Grounding system resistance to ground shall not exceed 5 ohms. Make any modifications or additions to the grounding electrode system necessary for compliance without additional cost to the Government. Final tests shall ensure that this requirement is met.

### **3.9 GROUND ROD INSTALLATION**

- A. For outdoor installations, drive each rod vertically in the earth, until top of rod is 610 mm (24 inches) below final grade.
- B. For indoor installations, leave 100 mm (4 inches) of each rod exposed.
- C. Where buried or permanently concealed ground connections are required, make the connections by the exothermic process, to form solid metal joints. Make accessible ground connections with mechanical pressure-type ground connectors.
- D. Where rock or impenetrable soil prevents the driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve the specified ground resistance.

### **3.10 ACCEPTANCE CHECKS AND TESTS**

- A. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized or connected to the electric utility company ground system, and shall be made in normally dry conditions not fewer than 48 hours after the last rainfall.
- B. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.
- C. Below-grade connections shall be visually inspected by the COR prior to backfilling. The Contractor shall notify the COR 24 hours before the connections are ready for inspection.

---END---

**SECTION 26 05 33**  
**RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation, and connection of conduit, fittings, and boxes, to form complete, coordinated, grounded raceway systems. Raceways are required for all wiring unless shown or specified otherwise.
- B. Definitions: The term conduit, as used in this specification, shall mean any or all of the raceway types specified.

**1.2 RELATED WORK**

- A. Section 06 10 00, ROUGH CARPENTRY: Mounting board for telephone closets.
- B. Section 07 60 00, FLASHING AND SHEET METAL: Fabrications for the deflection of water away from the building envelope at penetrations.
- C. Section 07 84 00, FIRESTOPPING: Sealing around penetrations to maintain the integrity of fire rated construction.
- D. Section 07 92 00, JOINT SEALANTS: Sealing around conduit penetrations through the building envelope to prevent moisture migration into the building.
- E. Section 09 91 00, PAINTING: Identification and painting of conduit and other devices.
- F. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.
- G. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

**1.3 QUALITY ASSURANCE**

- A. Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 SUBMITTALS**

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
  - 1. Shop Drawings:
    - a. Size and location of main feeders.
    - b. Size and location of panels and pull-boxes.
    - c. Layout of required conduit penetrations through structural elements.
    - d. Submit the following data for approval:
      - 1) Raceway types and sizes.
      - 2) Conduit bodies, connectors and fittings.
      - 3) Junction and pull boxes, types and sizes.
  - 2. Certifications: Two weeks prior to final inspection, submit the following:

- a. Certification by the manufacturer that raceways, conduits, conduit bodies, connectors, fittings, junction and pull boxes, and all related equipment conform to the requirements of the drawings and specifications.
- b. Certification by the Contractor that raceways, conduits, conduit bodies, connectors, fittings, junction and pull boxes, and all related equipment have been properly installed.

### 1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. American National Standards Institute (ANSI):
  - C80.1-05 ..... Electrical Rigid Steel Conduit
  - C80.3-05 ..... Steel Electrical Metal Tubing
  - C80.6-05 ..... Electrical Intermediate Metal Conduit
- C. National Fire Protection Association (NFPA):
  - 70-14 ..... National Electrical Code (NEC)
- D. Underwriters Laboratories, Inc. (UL):
  - 1-05 ..... Flexible Metal Conduit
  - 5-11 ..... Surface Metal Raceway and Fittings
  - 6-07 ..... Electrical Rigid Metal Conduit - Steel
  - 50-95 ..... Enclosures for Electrical Equipment
  - 360-13 ..... Liquid-Tight Flexible Steel Conduit
  - 467-13 ..... Grounding and Bonding Equipment
  - 514A-13 ..... Metallic Outlet Boxes
  - 514B-12 ..... Conduit, Tubing, and Cable Fittings
  - 514C-07 ..... Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers
  - 651-11 ..... Schedule 40 and 80 Rigid PVC Conduit and Fittings
  - 651A-11 ..... Type EB and A Rigid PVC Conduit and HDPE Conduit
  - 797-07 ..... Electrical Metallic Tubing
  - 1242-06 ..... Electrical Intermediate Metal Conduit - Steel
- E. National Electrical Manufacturers Association (NEMA):
  - TC-2-13 ..... Electrical Polyvinyl Chloride (PVC) Tubing and Conduit
  - TC-3-13 ..... PVC Fittings for Use with Rigid PVC Conduit and Tubing
  - FB1-12 ..... Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable
  - FB2.10-13 ..... Selection and Installation Guidelines for Fittings for use with Non-Flexible Conduit or Tubing (Rigid Metal Conduit, Intermediate Metallic Conduit, and Electrical Metallic Tubing)

FB2.20-12 ..... Selection and Installation Guidelines for Fittings for use with  
Flexible Electrical Conduit and Cable

F. American Iron and Steel Institute (AISI):

S100-2007 ..... North American Specification for the Design of Cold-Formed  
Steel Structural Members

## **PART 2 - PRODUCTS**

### **2.1 MATERIAL**

A. Conduit Size: In accordance with the NEC, but not less than 0.75-inch unless otherwise shown.  
Where permitted by the NEC, 0.5-inch flexible conduit may be used for tap connections to  
recessed lighting fixtures.

B. Conduit:

1. Size: In accordance with the NEC, but not less than 0.75-inch.
2. Rigid Steel Conduit (RMC): Shall conform to UL 6 and ANSI C80.1.
3. Rigid Intermediate Steel Conduit (IMC): Shall conform to UL 1242 and ANSI C80.6.
4. Electrical Metallic Tubing (EMT): Shall conform to UL 797 and ANSI C80.3. Maximum size  
not to exceed 105 mm (4 inches) and shall be permitted only with cable rated 600 V or less.
5. Flexible Metal Conduit: Shall conform to UL 1.
6. Liquid-tight Flexible Metal Conduit: Shall conform to UL 360.
7. Direct Burial Plastic Conduit: Shall conform to UL 651 and UL 651A, heavy wall PVC or high  
density polyethylene (PE).
8. Surface Metal Raceway: Shall conform to UL 5.

C. Conduit Fittings:

1. Rigid Steel and Intermediate Metallic Conduit Fittings:
  - a. Fittings shall meet the requirements of UL 514B and NEMA FB1.
  - b. Standard threaded couplings, locknuts, bushings, conduit bodies, and elbows: Only steel  
or malleable iron materials are acceptable. Integral retractable type IMC couplings are  
also acceptable.
  - c. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
  - d. Bushings: Metallic insulating type, consisting of an insulating insert, molded or locked  
into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic  
material are not permitted.
  - e. Erickson (Union-Type) and Set Screw Type Couplings: Approved for use in concrete are  
permitted for use to complete a conduit run where conduit is installed in concrete. Use  
set screws of case-hardened steel with hex head and cup point to firmly seat in conduit  
wall for positive ground. Tightening of set screws with pliers is prohibited.
  - f. Sealing Fittings: Threaded cast iron type. Use continuous drain-type sealing fittings to  
prevent passage of water vapor. In concealed work, install fittings in flush steel boxes

with blank cover plates having the same finishes as that of other electrical plates in the room.

2. Electrical Metallic Tubing Fittings:
  - a. Fittings and conduit bodies shall meet the requirements of UL 514B, ANSI C80.3, and NEMA FB1.
  - b. Only steel or malleable iron materials are acceptable.
  - c. Compression Couplings and Connectors: Concrete-tight and rain-tight, with connectors having insulated throats for conduit 2" and smaller.
  - d. Setscrew Couplings and Connectors: Use setscrews of case-hardened steel with hex head and cup point, to firmly seat in wall of conduit for positive grounding for conduit larger than 2".
  - e. Indent-type connectors or couplings are prohibited.
  - f. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.
3. Flexible Metal Conduit Fittings:
  - a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
  - b. Clamp-type, with insulated throat.
4. Liquid-tight Flexible Metal Conduit Fittings:
  - a. Fittings shall meet the requirements of UL 514B and NEMA FB1.
  - b. Only steel or malleable iron materials are acceptable.
  - c. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.
5. Direct Burial Plastic Conduit Fittings: Fittings shall meet the requirements of UL 514C and NEMA TC3.
6. Surface Metal Raceway Fittings: As recommended by the raceway manufacturer. Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, conduit entry fittings, accessories, and other fittings as required for complete system.
7. Expansion and Deflection Couplings:
  - a. Conform to UL 467 and UL 514B.
  - b. Accommodate a 19 mm (0.75-inch) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
  - c. Include internal flexible metal braid, sized to guarantee conduit ground continuity and a low-impedance path for fault currents, in accordance with UL 467 and the NEC tables for equipment grounding conductors.
  - d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat-resistant molded rubber material with stainless steel jacket clamps.
- D. Conduit Supports:
  1. Parts and Hardware: Zinc-coat or provide equivalent corrosion protection.

2. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
  3. Multiple Conduit (Trapeze) Hangers: Not less than 38 mm x 38 mm (1.5 x 1.5 inches), 12-gauge steel, cold-formed, lipped channels; with not less than 9 mm (0.375-inch) diameter steel hanger rods.
  4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.
- E. Outlet, Junction, and Pull Boxes:
1. UL-50 and UL-514A.
  2. Rustproof cast metal where required by the NEC or shown on drawings.
  3. Sheet Metal Boxes: Galvanized steel, except where shown on drawings.
- F. Metal Wireways: Equip with hinged covers, except as shown on drawings. Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for a complete system.

### **PART 3 - EXECUTION**

#### **3.1 PENETRATIONS**

- A. Cutting or Holes:
1. Cut holes in advance where they should be placed in the structural elements, such as ribs or beams. Obtain the approval of the COR prior to drilling through structural elements.
  2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammers, impact electric, hand, or manual hammer-type drills are not allowed, except when permitted by the COR where working space is limited.
- B. Firestop: Where conduits, wireways, and other electrical raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING.
- C. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal the gap around conduit to render it watertight, as specified in Section 07 92 00, JOINT SEALANTS.

#### **3.2 INSTALLATION, GENERAL**

- A. In accordance with UL, NEC, NEMA, as shown on drawings, and as specified herein.
- B. Raceway systems used for Essential Electrical Systems (EES) shall be entirely independent of other raceway systems.
- C. Install conduit as follows:
1. In complete mechanically and electrically continuous runs before pulling in cables or wires.
  2. Unless otherwise indicated on the drawings or specified herein, installation of all conduits shall be concealed within finished walls, floors, and ceilings.
  3. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new conduits.

4. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
  5. Cut conduits square, ream, remove burrs, and draw up tight.
  6. Independently support conduit at 2.4 M (8 feet) on centers with specified materials and as shown on drawings.
  7. Do not use suspended ceilings, suspended ceiling supporting members, lighting fixtures, other conduits, cable tray, boxes, piping, or ducts to support conduits and conduit runs.
  8. Support within 300 mm (12 inches) of changes of direction, and within 300 mm (12 inches) of each enclosure to which connected.
  9. Close ends of empty conduits with plugs or caps at the rough-in stage until wires are pulled in, to prevent entry of debris.
  10. Conduit installations under fume and vent hoods are prohibited.
  11. Secure conduits to cabinets, junction boxes, pull-boxes, and outlet boxes with bonding type locknuts. For rigid steel and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.
  12. Flashing of penetrations of the roof membrane is specified in Section 07 60 00, FLASHING AND SHEET METAL.
  13. Conduit bodies shall only be used for changes in direction, and shall not contain splices.
- D. Conduit Bends:
1. Make bends with standard conduit bending machines.
  2. Conduit hickey may be used for slight offsets and for straightening stubbed out conduits.
  3. Bending of conduits with a pipe tee or vise is prohibited.
- E. Layout and Homeruns:
1. Install conduit with wiring, including homeruns, as shown on drawings.
  2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted and approved by the COR.
- F. Conduit shall be run concealed in all finished areas of new construction and elsewhere unless specifically indicated or upon specific permission by the COR. All conduit shall parallel building lines.
- G. Conduit shall be run overhead and shall not be run below concrete slabs unless specifically indicated on the drawings and in the legend on the drawings.
- H. Contractor shall record carefully on a set of "as built" prints the exact location of all feeder conduits.
- I. Unless noted otherwise on the drawings, a maximum of 8 conductors shall be installed in a branch circuit conduit. This maximum is a count of all phase and neutral conductors only - ground conductors are not counted when determining maximum fill for this purpose.



### 3.3 CONCEALED WORK INSTALLATION

A. In Concrete:

1. Conduit: Rigid steel, IMC, or EMT. Do not install EMT in concrete slabs that are in contact with soil, gravel, or vapor barriers.
2. Align and run conduit in direct lines.
3. Install conduit through concrete beams only:
  - a. Where shown on the structural drawings.
  - b. As approved by the COR prior to construction, and after submittal of drawing showing location, size, and position of each penetration.
4. Installation of conduit in concrete that is less than 75 mm (3 inches) thick is prohibited.
  - a. Conduit outside diameter larger than one-third of the slab thickness is prohibited.
  - b. Space between conduits in slabs: Approximately six conduit diameters apart, and one conduit diameter at conduit crossings.
  - c. Install conduits approximately in the center of the slab so that there will be a minimum of 19 mm (0.75-inch) of concrete around the conduits.
5. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to ensure low resistance ground continuity through the conduits. Tightening setscrews with pliers is prohibited.

B. Above Furred or Suspended Ceilings and in Walls:

1. Conduit for Conductors Above 600 V: Rigid steel. Mixing different types of conduits in the same system is prohibited.
2. Conduit for Conductors 600 V and Below: Rigid steel, IMC, or EMT. Mixing different types of conduits in the same system is prohibited.
3. Align and run conduit parallel or perpendicular to the building lines.
4. Connect recessed lighting fixtures to conduit runs with maximum 1.8 M (6 feet) of flexible metal conduit extending from a junction box to the fixture.
5. Tightening set screws with pliers is prohibited.
6. For conduits running through metal studs, limit field cut holes to no more than 70% of web depth. Spacing between holes shall be at least 457 mm (18 inches). Cuts or notches in flanges or return lips shall not be permitted.

### 3.4 EXPOSED WORK INSTALLATION

- A. Unless otherwise indicated on drawings, exposed conduit is only permitted in mechanical and electrical rooms.
- B. Conduit for Conductors Above 600 V: Rigid steel. Mixing different types of conduits in the system is prohibited.
- C. Conduit for Conductors 600 V and Below: Rigid steel, IMC, or EMT. Mixing different types of conduits in the system is prohibited.

- D. Align and run conduit parallel or perpendicular to the building lines.
- E. Install horizontal runs close to the ceiling or beams and secure with conduit straps.
- F. Support horizontal or vertical runs at not over 2.4 M (8 feet) intervals.
- G. Surface Metal Raceways: Use only where shown on drawings.
- H. Painting:
  - 1. Paint exposed conduit as specified in Section 09 91 00, PAINTING.
  - 2. Paint all conduits containing cables rated over 600 V safety orange. Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color. In addition, paint legends, using 50 mm (2 inch) high black numerals and letters, showing the cable voltage rating. Provide legends where conduits pass through walls and floors and at maximum 6 M (20 feet) intervals in between.

### **3.5 NOT USED**

### **3.6 HAZARDOUS LOCATIONS**

- A. Use rigid steel conduit only.
- B. Install UL approved sealing fittings that prevent passage of explosive vapors in hazardous areas equipped with explosion-proof lighting fixtures, switches, and receptacles, as required by the NEC.

### **3.7 WET OR DAMP LOCATIONS**

- A. Use rigid steel or IMC conduits unless as shown on drawings.
- B. Provide sealing fittings to prevent passage of water vapor where conduits pass from warm to cold locations, i.e., refrigerated spaces, constant-temperature rooms, air-conditioned spaces, building exterior walls, roofs, or similar spaces.
- C. Use rigid steel or IMC conduit within 1.5 M (5 feet) of the exterior and below concrete building slabs in contact with soil, gravel, or vapor barriers, unless as shown on drawings. Conduit shall be half-lapped with 10 mil PVC tape before installation. After installation, completely recoat or retape any damaged areas of coating.
- D. Conduits run on roof shall be supported with integral galvanized lipped steel channel, attached to UV-inhibited polycarbonate or polypropylene blocks every 2.4 M (8 feet) with 9 mm (3/8-inch) galvanized threaded rods, square washer and locknut. Conduits shall be attached to steel channel with conduit clamps.

### **3.8 MOTORS AND VIBRATING EQUIPMENT**

- A. Use flexible metal conduit for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission.
- B. Use liquid-tight flexible metal conduit for installation in exterior locations, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray wash-down operations, inside airstream of HVAC units, and locations subject to seepage or dripping of oil, grease, or water.

- C. Provide a green equipment grounding conductor with flexible and liquid-tight flexible metal conduit.

### **3.9 EXPANSION JOINTS**

- A. Conduits 75 mm (3 inch) and larger that are secured to the building structure on opposite sides of a building expansion joint require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.
- B. Provide conduits smaller than 75 mm (3 inch) with junction boxes on both sides of the expansion joint. Connect flexible metal conduits to junction boxes with sufficient slack to produce a 125 mm (5 inch) vertical drop midway between the ends of the flexible metal conduit. Flexible metal conduit shall have a green insulated copper bonding jumper installed. In lieu of this flexible metal conduit, expansion and deflection couplings as specified above are acceptable.
- C. Install expansion and deflection couplings where shown.
- D. Seismic Areas: In seismic areas, provide conduits rigidly secured to the building structure on opposite sides of a building expansion joint with junction boxes on both sides of the joint. Connect conduits to junction boxes with 375 mm (15 inches) of slack flexible conduit. Flexible conduit shall have a copper bonding jumper installed.

### **3.10 CONDUIT SUPPORTS**

- A. Safe working load shall not exceed one-quarter of proof test load of fastening devices.
- B. Use pipe straps or individual conduit hangers for supporting individual conduits.
- C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and an additional 90 kg (200 lbs). Attach each conduit with U-bolts or other approved fasteners.
- D. Support conduit independently of junction boxes, pull-boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.
- E. Fasteners and Supports in Solid Masonry and Concrete:
  - 1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
  - 2. Existing Construction:
    - a. Steel expansion anchors not less than 6 mm (0.25-inch) bolt size and not less than 28 mm (1.125 inch) in embedment.
    - b. Power set fasteners not less than 6 mm (0.25-inch) diameter with depth of penetration not less than 75 mm (3 inch).
    - c. Use vibration and shock-resistant anchors and fasteners for attaching to concrete ceilings.
- F. Hollow Masonry: Toggle bolts.
- G. Bolts supported only by plaster or gypsum wallboard are not acceptable.

- H. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.
- I. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.
- J. Chain, wire, or perforated strap shall not be used to support or fasten conduit.
- K. Spring steel type supports or fasteners are prohibited for all uses except horizontal and vertical supports/fasteners within walls.
- L. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

### **3.11 BOX INSTALLATION**

- A. Boxes for Concealed Conduits:
  - 1. Flush-mounted.
  - 2. Provide raised covers for boxes to suit the wall or ceiling, construction, and finish.
- B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling-in operations or where more than the equivalent of 4-90 degree bends are necessary.
- C. Locate pullboxes so that covers are accessible and easily removed. Coordinate locations with piping and ductwork where installed above ceilings.
- D. Remove only knockouts as required. Plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.
- E. Outlet boxes mounted back-to-back in the same wall are prohibited. A minimum 600 mm (24 inch) center-to-center lateral spacing shall be maintained between boxes.
- F. Flush-mounted wall or ceiling boxes shall be installed with raised covers so that the front face of raised cover is flush with the wall. Surface-mounted wall or ceiling boxes shall be installed with surface-style flat or raised covers.
- G. Minimum size of outlet boxes for ground fault circuit interrupter (GFCI) receptacles is 100 mm (4 inches) square x 55 mm (2.125 inches) deep, with device covers for the wall material and thickness involved.
- H. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "SIG-FA JB No. 1."
- I. On all branch circuit junction box covers, identify the circuits with black marker.

- - - E N D - - -

**SECTION 26 27 26**  
**WIRING DEVICES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation, connection, and testing of wiring devices.

**1.2 RELATED WORK**

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one section of Division 26.
- B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Cables and wiring.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.
- D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit and boxes.
- E. Section 26 51 00, INTERIOR LIGHTING: Fluorescent ballasts and LED drivers for use with manual dimming controls.

**1.3 QUALITY ASSURANCE**

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 SUBMITTALS**

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
1. Shop Drawings:
    - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
    - b. Include electrical ratings, dimensions, mounting details, construction materials, grade, and termination information.
  2. Manuals:
    - a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals, including technical data sheets and information for ordering replacement parts.
    - b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
  3. Certifications: Two weeks prior to final inspection, submit the following.
    - a. Certification by the manufacturer that the wiring devices conform to the requirements of the drawings and specifications.

- b. Certification by the Contractor that the wiring devices have been properly installed and adjusted.

## 1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.
- B. National Fire Protection Association (NFPA):
  - 70-14 ..... National Electrical Code (NEC)
  - 99-15 ..... Health Care Facilities
- C. National Electrical Manufacturers Association (NEMA):
  - WD 1-10 ..... General Color Requirements for Wiring Devices
  - WD 6-12 ..... Wiring Devices – Dimensional Specifications
- D. Underwriter's Laboratories, Inc. (UL):
  - 5-11 ..... Surface Metal Raceways and Fittings
  - 20-10 ..... General-Use Snap Switches
  - 231-08 ..... Power Outlets
  - 467-13 ..... Grounding and Bonding Equipment
  - 498-12 ..... Attachment Plugs and Receptacles
  - 943-15 ..... Ground-Fault Circuit-Interrupters
  - 1449-14 ..... Surge Protective Devices
  - 1472-15 ..... Solid State Dimming Controls

## PART 2 - PRODUCTS

### 2.1 RECEPTACLES

- A. General: All receptacles shall comply with NEMA, NFPA, UL, and as shown on the drawings.
  - 1. Mounting straps shall be nickel plated brass, brass, nickel plated steel or galvanize steel with break-off plaster ears, and shall include a self-grounding feature. Terminal screws shall be brass, brass plated or a copper alloy metal.
  - 2. Receptacles shall have provisions for back wiring with separate metal clamp type terminals (four minimum) and side wiring from four captively held binding screws.
- B. Duplex Receptacles - Hospital-grade: shall be listed for hospital grade, single phase, 20 ampere, 120 volts, 2-pole, 3-wire, NEMA 5-20R, with break-off feature for two-circuit operation.
  - 1. Bodies shall be ivory in color.
  - 2. Switched duplex receptacles shall be wired so that only the top receptacle is switched. The lower receptacle shall be unswitched.
  - 3. Duplex Receptacles on Emergency Circuit:
    - a. In rooms without emergency powered general lighting, the emergency receptacles shall be of the self-illuminated type.

- b. Shall have red bodies.
- 4. Ground Fault Current Interrupter (GFCI) Duplex Receptacles: Shall be an integral unit, hospital-grade, suitable for mounting in a standard outlet box, with end-of-life indication and provisions to isolate the face due to improper wiring. GFCI receptacles shall be self-test receptacles in accordance with UL 943.
  - a. Ground fault interrupter shall consist of a differential current transformer, self-test, solid state sensing circuitry and a circuit interrupter switch. Device shall have nominal sensitivity to ground leakage current of 4-6 milliamperes and shall function to interrupt the current supply for any value of ground leakage current above five milliamperes (+ or – 1 milliampere) on the load side of the device. Device shall have a minimum nominal tripping time of 0.025 second.
  - b. Self-test function shall be automatically initiated within 5 seconds after power is activated to the receptacles. Self-test function shall be periodically and automatically performed every 3 hours or less.
  - c. End-of-life indicator light shall be a persistent flashing or blinking light to indicate that the GFCI receptacle is no longer in service.
- C. Receptacles - 20, 30, and 50 ampere, 250 Volts: Shall be complete with appropriate cord grip plug.
- D. Weatherproof Receptacles: Shall consist of a duplex receptacle, mounted in box with a gasketed, weatherproof, cast metal cover plate and cap over each receptacle opening. The cap shall be permanently attached to the cover plate by a spring-hinged flap. The weatherproof integrity shall not be affected when heavy duty specification or hospital grade attachment plug caps are inserted. Cover plates on outlet boxes mounted flush in the wall shall be gasketed to the wall in a watertight manner.
- E. Surge Protective (TVSS) Receptacles shall have integral surge suppression in line to ground, line to neutral, and neutral to ground modes.
  - 1. TVSS Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 400 Volts, and minimum single transient pulse energy dissipation of 210 Joules.
  - 2. Active TVSS Indication: LED, visible in face of device to indicate device is active or no longer in service.

## **2.2 TOGGLE SWITCHES**

- A. Toggle switches shall be totally enclosed tumbler type with nylon bodies. Handles shall be ivory in color unless otherwise specified or shown on the drawings.
  - 1. Switches installed in hazardous areas shall be explosion-proof type in accordance with the NEC and as shown on the drawings.

2. Shall be single unit toggle, butt contact, quiet AC type, heavy-duty general-purpose use with an integral self grounding mounting strap with break-off plaster ears and provisions for back wiring with separate metal wiring clamps and side wiring with captively held binding screws.
3. Switches shall be rated 20 amperes at 120-277 Volts AC.
4. Switches on emergency power shall be red.

## **2.3 MANUAL DIMMING CONTROL**

- A. Electronic full-wave manual slide dimmer with on/off switch and audible frequency and EMI/RFI suppression filters.
- B. Manual dimming controls shall be fully compatible with LED dimming driver and be approved by the driver manufacturer, shall operate over full specified dimming range, and shall not degrade the performance or rated life of the electronic dimming ballast and lamp.
- C. Provide single-pole, three-way or four-way, as shown on the drawings.
- D. Manual dimming control and faceplates shall be ivory in color unless otherwise specified.

## **2.4 WALL PLATES**

- A. Wall plates for switches and receptacles shall be type 302 stainless steel. Oversize plates are not acceptable.
- B. For receptacles or switches mounted adjacent to each other, wall plates shall be common for each group of receptacles or switches.
- C. In areas requiring tamperproof wiring devices, wall plates shall be type 302 stainless steel, and shall have tamperproof screws and beveled edges.
- D. Duplex Receptacles on Emergency Circuit: Wall plates shall be type 302 stainless steel, with the word "EMERGENCY" engraved in 6 mm (1/4 inch) red letters.

## **2.5 SURFACE MULTIPLE-OUTLET ASSEMBLIES**

- A. Shall have the following features:
  1. Enclosures:
    - a. Thickness of steel shall be not less than 1 mm (0.040 inch) for base and cover. Nominal dimensions shall be 40 mm x 70 mm (1-1/2 inches by 2-3/4 inches) with inside cross sectional area not less than 2250 square mm (3-1/2 square inches). The enclosures shall be thoroughly cleaned, phosphatized, and painted at the factory with primer and the manufacturer's standard baked enamel finish.
  2. Receptacles shall be duplex, hospital grade. See paragraph 'RECEPTACLES' in this Section. Device cover plates shall be the manufacturer's standard corrosion resistant finish and shall not exceed the dimensions of the enclosure.
  3. Unless otherwise shown on drawings, receptacle spacing shall be 600 mm (24 inches) on centers.
  4. Conductors shall be as specified in Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.



5. Installation fittings shall be the manufacturer's standard bends, offsets, device brackets, inside couplings, wire clips, elbows, and other components as required for a complete system.
6. Bond the assemblies to the branch circuit conduit system.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Installation shall be in accordance with the NEC and as shown as on the drawings.
- B. Install wiring devices after wall construction and painting is complete.
- C. The ground terminal of each wiring device shall be bonded to the outlet box with an approved green bonding jumper, and also connected to the branch circuit equipment grounding conductor.
- D. Outlet boxes for toggle switches and manual dimming controls shall be mounted on the strike side of doors.
- E. Provide barriers in multi-gang outlet boxes to comply with the NEC.
- F. Coordinate the electrical work with the work of other trades to ensure that wiring device flush outlets are positioned with box openings aligned with the face of the surrounding finish material. Pay special attention to installations in cabinet work, and in connection with laboratory equipment.
- G. Exact field locations of floors, walls, partitions, doors, windows, and equipment may vary from locations shown on the drawings. Prior to locating sleeves, boxes and chases for roughing-in of conduit and equipment, the Contractor shall coordinate exact field location of the above items with other trades.
- H. Install wall switches 1.2 M (48 inches) above floor, with the toggle OFF position down.
- I. Install wall dimmers 1.2 M (48 inches) above floor.
- J. Install receptacles 450 mm (18 inches) above floor, and 152 mm (6 inches) above counter backsplash or workbenches. Install specific-use receptacles at heights shown on the drawings.
- K. Install horizontally mounted receptacles with the ground pin to the right.
- L. When required or recommended by the manufacturer, use a torque screwdriver. Tighten unused terminal screws.
- M. Label device plates with a permanent adhesive label listing panel and circuit feeding the wiring device.

#### **3.2 ACCEPTANCE CHECKS AND TESTS**

- A. Perform manufacturer's required field checks in accordance with the manufacturer's recommendations, and the latest NFPA 99. In addition, include the following:
  1. Visual Inspection and Tests:
    - a. Inspect physical and electrical conditions.
    - b. Vacuum-clean surface metal raceway interior. Clean metal raceway exterior.
    - c. Test wiring devices for damaged conductors, high circuit resistance, poor connections, inadequate fault current path, defective devices, or similar problems using a portable

receptacle tester. Correct circuit conditions, remove malfunctioning units and replace with new, and retest as specified above.

- d. Test GFCI receptacles.
- 2. Receptacle testing in the Patient Care Spaces, such as retention force of the grounding blade of each receptacle, shall comply with the latest NFPA 99.

---END---

**SECTION 26 51 00  
INTERIOR LIGHTING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

- A. This section specifies the furnishing, installation, and connection of the interior lighting systems.  
The terms "lighting fixture," "fixture," and "luminaire" are used interchangeably.

**1.2 RELATED WORK**

- A. Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT: Disposal of lamps.
- B. Not Used
- C. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- D. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
- E. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.
- F. Section 26 27 26, WIRING DEVICES: Wiring devices used for control of the lighting systems.

**1.3 QUALITY ASSURANCE**

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 SUBMITTALS**

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
  - 1. Shop Drawings:
    - a. Submit the following information for each type of lighting fixture designated on the LIGHTING FIXTURE SCHEDULE, arranged in order of lighting fixture designation.
    - b. Material and construction details, include information on housing and optics system.
    - c. Physical dimensions and description.
    - d. Wiring schematic and connection diagram.
    - e. Installation details.
    - f. Energy efficiency data.
    - g. Photometric data based on laboratory tests complying with IES Lighting Measurements testing and calculation guides.
    - h. Lamp data including lumen output (initial and mean), color rendition index (CRI), rated life (hours), and color temperature (degrees Kelvin).
    - i. Ballast data including ballast type, starting method, ambient temperature, ballast factor, sound rating, system watts, and total harmonic distortion (THD).

- j. For LED lighting fixtures, submit US DOE LED Lighting Facts label, and IES L70 rated life.
- 2. Manuals:
  - a. Submit, simultaneously with the shop drawings, complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.
  - b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
- 3. Certifications: Two weeks prior to final inspection, submit the following.
  - a. Certification by the Contractor that the interior lighting systems have been properly installed and tested.

### 1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. American National Standards Institute (ANSI):
  - C78.1-91 ..... Fluorescent Lamps - Rapid-Start Types - Dimensional and Electrical Characteristics
  - C78.376-01 ..... Chromaticity of Fluorescent Lamps
- C. American Society for Testing and Materials (ASTM):
  - C635-07 ..... Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
- D. Environmental Protection Agency (EPA):
  - 40 CFR 261 ..... Identification and Listing of Hazardous Waste
- E. Federal Communications Commission (FCC):
  - CFR Title 47, Part 15 ..... Radio Frequency Devices
  - CFR Title 47, Part 18 ..... Industrial, Scientific, and Medical Equipment
- F. Illuminating Engineering Society (IES):
  - LM-79-08 ..... Electrical and Photometric Measurements of Solid-State Lighting Products
  - LM-80-08 ..... Measuring Lumen Maintenance of LED Light Sources
  - LM-82-12 ..... Characterization of LED Light Engines and LED Lamps for Electrical and Photometric Properties as a Function of Temperature
- G. Institute of Electrical and Electronic Engineers (IEEE):
  - C62.41-91 ..... Surge Voltages in Low Voltage AC Power Circuits

- H. International Code Council (ICC):
  - IBC-12 ..... International Building Code
- I. National Fire Protection Association (NFPA):
  - 70-14 ..... National Electrical Code (NEC)
  - 101-12 ..... Life Safety Code
- J. National Electrical Manufacturer's Association (NEMA):
  - C82.1-04 ..... Lamp Ballasts – Line Frequency Fluorescent Lamp Ballasts
  - C82.2-02 ..... Method of Measurement of Fluorescent Lamp Ballasts
  - C82.4-02 ..... Lamp Ballasts - Ballasts for High-Intensity Discharge and Low-Pressure Sodium (LPS) Lamps (Multiple-Supply Type)
  - C82.11-11 ..... Lamp Ballasts - High Frequency Fluorescent Lamp Ballasts
  - LL-9-09 ..... Dimming of T8 Fluorescent Lighting Systems
  - SSL-1-10 ..... Electronic Drivers for LED Devices, Arrays, or Systems
- K. Underwriters Laboratories, Inc. (UL):
  - 496-08 ..... Lampholders
  - 542-0599 ..... Fluorescent Lamp Starters
  - 844-12 ..... Luminaires for Use in Hazardous (Classified) Locations
  - 924-12 ..... Emergency Lighting and Power Equipment
  - 935-01 ..... Fluorescent-Lamp Ballasts
  - 1029-94 ..... High-Intensity-Discharge Lamp Ballasts
  - 1029A-06 ..... Ignitors and Related Auxiliaries for HID Lamp Ballasts
  - 1598-08 ..... Luminaires
  - 1574-04 ..... Track Lighting Systems
  - 2108-04 ..... Low-Voltage Lighting Systems
  - 8750-09 ..... Light Emitting Diode (LED) Light Sources for Use in Lighting Products

## **PART 2 - PRODUCTS**

### **2.1 LIGHTING FIXTURES**

- A. Shall be in accordance with NFPA, UL, as shown on drawings, and as specified.
- B. Sheet Metal:
  - 1. Shall be formed to prevent warping and sagging. Housing, trim and lens frame shall be true, straight (unless intentionally curved), and parallel to each other as designed.
  - 2. Wireways and fittings shall be free of burrs and sharp edges, and shall accommodate internal and branch circuit wiring without damage to the wiring.
  - 3. When installed, any exposed fixture housing surface, trim frame, door frame, and lens frame shall be free of light leaks.
  - 4. Hinged door frames shall operate smoothly without binding. Latches shall function easily by finger action without the use of tools.

- C. Ballasts and lamps shall be serviceable while the fixture is in its normally installed position.  
Ballasts shall not be mounted to removable reflectors or wireway covers unless so specified.
- D. Lamp Sockets:
  - 1. Fluorescent: Single slot entry type, requiring a one-quarter turn of the lamp after insertion.  
Lampholder contacts shall be the biting edge type.
  - 2. Compact Fluorescent: 4-pin.
  - 3. High Intensity Discharge (HID): Porcelain.
- E. Recessed fixtures mounted in an insulated ceiling shall be listed for use in insulated ceilings.
- F. Mechanical Safety: Lighting fixture closures (lens doors, trim frame, hinged housings, etc.) shall be retained in a secure manner by captive screws, chains, aircraft cable, captive hinges, or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.
- G. Metal Finishes:
  - 1. The manufacturer shall apply standard finish (unless otherwise specified) over a corrosion-resistant primer, after cleaning to free the metal surfaces of rust, grease, dirt and other deposits. Edges of pre-finished sheet metal exposed during forming, stamping or shearing processes shall be finished in a similar corrosion resistant manner to match the adjacent surface(s). Fixture finish shall be free of stains or evidence of rusting, blistering, or flaking, and shall be applied after fabrication.
  - 2. Interior light reflecting finishes shall be white with not less than 85 percent reflectances, except where otherwise shown on the drawing.
  - 3. Exterior finishes shall be as shown on the drawings.
- H. Lighting fixtures shall have a specific means for grounding metallic wireways and housings to an equipment grounding conductor.
- I. Light Transmitting Components for Fluorescent Fixtures:
  - 1. Shall be 100 percent virgin acrylic.
  - 2. Flat lens panels shall have not less than 3 mm (1/8 inch) of average thickness.
  - 3. Unless otherwise specified, lenses, reflectors, diffusers, and louvers shall be retained firmly in a metal frame by clips or clamping ring in such a manner as to allow expansion and contraction without distortion or cracking.
- J. Lighting fixtures in hazardous areas shall be suitable for installation in Class and Division areas as defined in NFPA 70.

## **2.2 BALLASTS**

- A. Linear Fluorescent Lamp Ballasts: Multi-voltage (120 – 277V), electronic programmed-start type, designed for type and quantity of lamps indicated. Ballasts shall be designed for full light output unless dimmer or bi-level control is indicated. Ballasts shall include the following features:
  - 1. Lamp end-of-life detection and shutdown circuit (T5 lamps only).

2. Automatic lamp starting after lamp replacement.
3. Sound Rating: Class A.
4. Total Harmonic Distortion (THD): 10 percent or less.
5. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
6. Operating Frequency: 20 kHz or higher.
7. Lamp Current Crest Factor: 1.7 or less.
8. Ballast Factor: 0.87 or higher unless otherwise indicated.
9. Power Factor: 0.98 or higher.
10. EMR/RFI Interference: Comply with CFR Title 47 Part 18 for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.
11. To facilitate multi-level lamp switching, lamps within fixture shall be wired with the outermost lamp at both sides of the fixture on the same ballast, the next inward pair on another ballast and so on to the innermost lamp (or pair of lamps). Within a given room, each switch shall uniformly control the same corresponding lamp (or lamp pairs) in all fixture units that are being controlled.
12. Where three-lamp fixtures are indicated, unless switching arrangements dictate otherwise, utilize a common two-lamp ballast to operate the center lamp in pairs of adjacent units that are mounted in a continuous row. The ballast fixture and slave-lamp fixture shall be factory wired with leads or plug devices to facilitate this circuiting. Individually mounted fixtures and the odd fixture in a row shall utilize a single-lamp ballast for operation of the center lamp.

## **2.3 LAMPS**

- A. Linear T8 Fluorescent Lamps:
  1. Except as indicated below, lamps shall be low-mercury energy saving type, have a color temperature between of 4100°K, a Color Rendering Index (CRI) equal or greater than 80, average rated life equal to or greater than 24,000 hours when used with an instant start ballast and 30,000 hours when used with a programmed or rapid start ballast (based on 3 hour starts), and be suitable for use with dimming ballasts, unless otherwise indicated.
  2. Lamps shall comply with EPA Toxicity Characteristic Leachate Procedure (TCLP) requirements.
  3. Lamps shall be Low Mercury type.

## **2.4 LED EXIT LIGHT FIXTURES**

- A. Exit light fixtures shall meet applicable requirements of NFPA and UL.
- B. Housing and door shall be die-cast aluminum.
- C. For general purpose exit light fixtures, door frame shall be hinged, with latch. For vandal-resistant exit light fixtures, door frame shall be secured with tamper-resistant screws.
- D. Finish shall be satin or fine-grain brushed aluminum.
- E. There shall be no radioactive material used in the fixtures.

F. Fixtures:

1. Inscription panels shall be cast or stamped aluminum a minimum of 2.25 mm (0.090 inch) thick, stenciled with 150 mm (6 inch) high letters, baked with red color stable plastic or fiberglass. Lamps shall be luminous Light Emitting Diodes (LED) mounted in center of letters on red color stable plastic or fiberglass.
2. Double-Faced Fixtures: Provide double-faced fixtures where required or as shown on drawings.
3. Directional Arrows: Provide directional arrows as part of the inscription panel where required or as shown on drawings. Directional arrows shall be the "chevron-type" of similar size and width as the letters and meet the requirements of NFPA 101.

G. Voltage: Multi-voltage (120 – 277V).

**2.5 LED LIGHT FIXTURES**

A. General:

1. LED light fixtures shall be in accordance with IES, NFPA, UL, as shown on the drawings, and as specified.
2. LED light fixtures shall be Reduction of Hazardous Substances (RoHS)-compliant.
3. LED drivers shall include the following features unless otherwise indicated:
  - a. Minimum efficiency: 85% at full load.
  - b. Minimum Operating Ambient Temperature: -20° C. (-4° F.)
  - c. Input Voltage: 120 - 277V (±10%) at 60 Hz.
  - d. Integral short circuit, open circuit, and overload protection.
  - e. Power Factor: ≥ 0.95.
  - f. Total Harmonic Distortion: ≤ 20%.
  - g. Comply with FCC 47 CFR Part 15.
  - h. LED light fixtures shall have at least a 5 year limited manufacturer's warranty covering drivers, modules, and integral control devices from defects in material and workmanship.
  - i. LED light fixtures shall be DesignLights Consortium (DLC) qualified.
4. LED modules shall include the following features unless otherwise indicated:
  - a. Comply with IES LM-79 and LM-80 requirements.
  - b. Minimum CRI 80 and color temperature 4100° K unless otherwise specified in LIGHTING FIXTURE SCHEDULE.
  - c. Minimum Rated Life: 50,000 hours per IES L70.
  - d. Light output lumens as indicated in the LIGHTING FIXTURE SCHEDULE.

B. LED Downlights:

1. Housing, LED driver, and LED module shall be products of the same manufacturer.

C. LED Troffers:



1. LED drivers, modules, and reflector shall be accessible, serviceable, and replaceable from below the ceiling.
2. Housing, LED driver, and LED module shall be products of the same manufacturer.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Installation shall be in accordance with the NEC, manufacturer's instructions, and as shown on the drawings or specified.
- B. Align, mount, and level the lighting fixtures uniformly.
- C. Wall-mounted fixtures shall be attached to the studs in the walls, or to a 20 gauge metal backing plate that is attached to the studs in the walls. Lighting fixtures shall not be attached directly to gypsum board.
- D. Lighting Fixture Supports:
  1. Shall provide support for all of the fixtures. Supports may be anchored to channels of the ceiling construction, to the structural slab or to structural members within a partition, or above a suspended ceiling.
  2. Shall maintain the fixture positions after cleaning and relamping.
  3. Shall support the lighting fixtures without causing the ceiling or partition to deflect.
  4. Hardware for recessed lighting fixtures:
    - a. All fixture mounting devices connecting fixtures to the ceiling system or building structure shall have a capacity for a horizontal force of 100 percent of the fixture weight and a vertical force of 400 percent of the fixture weight.
    - b. Mounting devices shall clamp the fixture to the ceiling system structure (main grid runners or fixture framing cross runners) at four points in such a manner as to resist spreading of these supporting members. Each support point device shall utilize a screw or approved hardware to "lock" the fixture housing to the ceiling system, restraining the fixture from movement in any direction relative to the ceiling. The screw (size No. 10 minimum) or approved hardware shall pass through the ceiling member (T-bar, channel or spline), or it may extend over the inside of the flange of the channel (or spline) that faces away from the fixture, in a manner that prevents any fixture movement.
    - c. In addition to the above, the following is required for fixtures exceeding 9 kg (20 pounds) in weight.
      - 1) Where fixtures mounted in ASTM Standard C635 "Intermediate Duty" and "Heavy Duty" ceilings and weigh between 9 kg and 25 kg (20 pounds and 56 pounds), provide two 12 gauge safety hangers hung slack between diagonal corners of the fixture and the building structure.

- 2) Where fixtures weigh over 25 kg (56 pounds), they shall be independently supported from the building structure by approved hangers. Two-way angular bracing of hangers shall be provided to prevent lateral motion.
- d. Where ceiling cross runners are installed for support of lighting fixtures, they must have a carrying capacity equal to that of the main ceiling runners and be rigidly secured to the main runners.
5. Surface mounted lighting fixtures:
  - a. Fixtures shall be bolted against the ceiling independent of the outlet box at four points spaced near the corners of each unit. The bolts (or stud-clips) shall be minimum 6 mm (1/4 inch) bolt, secured to main ceiling runners and/or secured to cross runners.  
Non-turning studs may be attached to the main ceiling runners and cross runners with special non-friction clip devices designed for the purpose, provided they bolt through the runner, or are also secured to the building structure by 12 gauge safety hangers. Studs or bolts securing fixtures weighing in excess of 25 kg (56 pounds) shall be supported directly from the building structure.
  - b. Where ceiling cross runners are installed for support of lighting fixtures, they must have a carrying capacity equal to that of the main ceiling runners and be rigidly secured to the main runners.
  - c. Fixtures less than 6.8 kg (15 pounds) in weight and occupying less than 3715 sq cm (two square feet) of ceiling area may, when designed for the purpose, be supported directly from the outlet box when all the following conditions are met.
    - 1) Screws attaching the fixture to the outlet box pass through round holes (not key-hole slots) in the fixture body.
    - 2) The outlet box is attached to a main ceiling runner (or cross runner) with approved hardware.
    - 3) The outlet box is supported vertically from the building structure.
  - d. Fixtures mounted in open construction shall be secured directly to the building structure with approved bolting and clamping devices.
6. Single or double pendant-mounted lighting fixtures:
  - a. Each stem shall be supported by an approved outlet box mounted swivel joint and canopy which holds the stem captive and provides spring load (or approved equivalent) dampening of fixture oscillations. Outlet box shall be supported vertically from the building structure.
7. Outlet boxes for support of lighting fixtures (where permitted) shall be secured directly to the building structure with approved devices or supported vertically in a hung ceiling from the building structure with a nine gauge wire hanger, and be secured by an approved device to a main ceiling runner or cross runner to prevent any horizontal movement relative to the ceiling.

- E. Furnish and install the new lamps as specified for all lighting fixtures installed under this project, and for all existing lighting fixtures reused under this project.
- F. The electrical and ceiling trades shall coordinate to ascertain that approved lighting fixtures are furnished in the proper sizes and installed with the proper devices (hangers, clips, trim frames, flanges, etc.), to match the ceiling system being installed.
- G. Bond lighting fixtures to the grounding system as specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- H. At completion of project, replace all defective components of the lighting fixtures at no cost to the Government.

### **3.2 ACCEPTANCE CHECKS AND TESTS**

- A. Perform the following:
  - 1. Visual Inspection:
    - a. Verify proper operation by operating the lighting controls.
    - b. Visually inspect for damage to fixtures, lenses, reflectors, diffusers, and louvers. Clean fixtures, lenses, reflectors, diffusers, and louvers that have accumulated dust, dirt, or fingerprints during construction.
  - 2. Electrical tests:
    - a. Exercise dimming components of the lighting fixtures over full range of dimming capability by operating the control device(s) in the presence of the COR. Observe for visually detectable flicker over full dimming range, and replace defective components at no cost to the Government.
    - b. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Government. Burn-in period to be 40 hours minimum, unless specifically recommended otherwise by the lamp manufacturer. Burn-in dimmed fluorescent and compact fluorescent lamps for at least 100 hours at full voltage, unless specifically recommended otherwise by the lamp manufacturer. Replace any lamps and ballasts which fail during burn-in.

### **3.3 FOLLOW-UP VERIFICATION**

- A. Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the lighting systems are in good operating condition and properly performing the intended function.

---END---

**SECTION 27 05 11**  
**REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section includes common requirements to communications installations and applies to all sections of Division 27.
- B. Provide completely functioning communications systems.
- C. Comply with VAAR 852.236.91 and FAR clause 52.236-21 in circumstance of a need for additional detail or conflict between drawings, specifications, reference standards or code.

**1.2 REFERENCES**

- A. Abbreviations and Acronyms
  - 1. Refer to <http://www.cfm.va.gov/til/sdetail.asp> for Division 00, ARCHITECTURAL ABBREVIATIONS.
  - 2. Additional Abbreviations and Acronyms:

A	Ampere
AC	Alternating Current
AE	Architect and Engineer
AFF	Above Finished Floor
AHJ	Authority Having Jurisdiction
ANSI	American National Standards Institute
AWG	American Wire Gauge (refer to STP and UTP)
AWS	Advanced Wireless Services
BCT	Bonding Conductor for Telecommunications (also Telecommunications Bonding Conductor (TBC))
BDA	Bi-Directional Amplifier
BICSI	Building Industry Consulting Service International
BIM	Building Information Modeling
BOM	Bill of Materials
BTU	British Thermal Units
BUCR	Back-up Computer Room
BTS	Base Transceiver Station
CAD	AutoCAD
CBOPC	Community Based Out Patient Clinic
CBC	Coupled Bonding Conductor
CBOC	Community Based Out Patient Clinic (refer to CBOPC, OPC, VAMC)
CCS	TIP's Cross Connection System (refer to VCCS and HCCS)

CFE	Contractor Furnished Equipment
CFM	US Department of Veterans Affairs Office of Construction and Facilities Management
CFR	Consolidated Federal Regulations
CIO	Communication Information Officer (Facility, VISN or Region)
cm	Centimeters
CO	Central Office
COR	Contracting Officer Representative
CPU	Central Processing Unit
CSU	Customer Service Unit
CUP	Conditional Use Permit(s) – Federal/GSA for VA
dB	Decibel
dBm	Decibel Measured
dBmV	Decibel per milli-Volt
DC	Direct Current
DEA	United States Drug Enforcement Administration
DSU	Data Service Unit
EBC	Equipment Bonding Conductor
ECC	Engineering Control Center (refer to DCR, EMCR)
EDGE	Enhanced Data (Rates) for GSM Evolution
EDM	Electrical Design Manual
EMCR	Emergency Management Control Room (refer to DCR, ECC)
EMI	Electromagnetic Interference (refer to RFI)
EMS	Emergency Medical Service
EMT	Electrical Metallic Tubing or thin wall conduit
ENTR	Utilities Entrance Location (refer to DEMARC, POTS, LEC)
EPBX	Electronic Digital Private Branch Exchange
ESR	Vendor's Engineering Service Report
FA	Fire Alarm
FAR	Federal Acquisition Regulations in Chapter 1 of Title 48 of Code of Federal Regulations
FMS	VA's Headquarters or Medical Center Facility's Management Service
FR	Frequency (refer to RF)
FTS	Federal Telephone Service
GFE	Government Furnished Equipment
GPS	Global Positioning System

GRC	Galvanized Rigid Metal Conduit
GSM	Global System (Station) for Mobile
HCCS	TIP's Horizontal Cross Connection System (refer to CCS & VCCS)
HDPE	High Density Polyethylene Conduit
HDTV	Advanced Television Standards Committee High-Definition Digital Television
HEC	Head End Cabinets(refer to HEIC, PA)
HEIC	Head End Interface Cabinets(refer to HEC, PA)
HF	High Frequency (Radio Band; Re FR, RF, VHF & UHF)
HSPA	High Speed Packet Access
HZ	Hertz
IBT	Intersystem Bonding Termination (NEC 250.94)
IC	Intercom
ICRA	Infectious Control Risk Assessment
IDEN	Integrated Digital Enhanced Network
IDC	Insulation Displacement Contact
IDF	Intermediate Distribution Frame
ILSM	Interim Life Safety Measures
IMC	Rigid Intermediate Steel Conduit
IRM	Department of Veterans Affairs Office of Information Resources Management
ISDN	Integrated Services Digital Network
ISM	Industrial, Scientific, Medical
IWS	Intra-Building Wireless System
LAN	Local Area Network
LBS	Location Based Services, Leased Based Systems
LEC	Local Exchange Carrier (refer to DEMARC, PBX & POTS)
LED	Light Emitting Diode
LMR	Land Mobile Radio
LTE	Long Term Evolution, or 4G Standard for Wireless Data Communications Technology
M	Meter
MAS	Medical Administration Service
MATV	Master Antenna Television
MCR	Main Computer Room
MCOR	Main Computer Operators Room
MDF	Main Distribution Frame
MH	Manholes or Maintenance Holes

MHz	Megahertz ( $10^6$ Hz)
mm	Millimeter
MOU	Memorandum of Understanding
MW	Microwave (RF Band, Equipment or Services)
NID	Network Interface Device (refer to DEMARC)
NEC	National Electric Code
NOR	Network Operations Room
NRTL	OSHA Nationally Recognized Testing Laboratory
NS	Nurse Stations
NTIA	U.S. Department of Commerce National Telecommunications and Information Administration
OEM	Original Equipment Manufacturer
OI&T	Office of Information and Technology
OPC	VA's Outpatient Clinic (refer to CBOC, VAMC)
OSH	Department of Veterans Affairs Office of Occupational Safety and Health
OSHA	United States Department of Labor Occupational Safety and Health Administration
OTDR	Optical Time-Domain Reflectometer
PA	Public Address System (refer to HE, HEIC, RPEC)
PBX	Private Branch Exchange (refer to DEMARC, LEC, POTS)
PCR	Police Control Room (refer to SPCC, could be designated SCC)
PCS	Personal Communications Service (refer to UPCS)
PE	Professional Engineer
PM	Project Manager
PoE	Power over Ethernet
POTS	Plain Old Telephone Service (refer to DEMARC, LEC, PBX)
PSTN	Public Switched Telephone Network
PSRAS	Public Safety Radio Amplification Systems
PTS	Pay Telephone Station
PVC	Poly-Vinyl Chloride
PWR	Power (in Watts)
RAN	Radio Access Network
RBB	Rack Bonding Busbar
RE	Resident Engineer or Senior Resident Engineer
RF	Radio Frequency (refer to FR)
RFI	Radio Frequency Interference (refer to EMI)

RFID	RF Identification (Equipment, System or Personnel)
RMC	Rigid Metal Conduit
RMU	Rack Mounting Unit
RPEC	Radio Paging Equipment Cabinets(refer to HEC, HEIC, PA)
RTLS	Real Time Location Service or System
RUS	Rural Utilities Service
SCC	Security Control Console (refer to PCR, SPCC)
SMCS	Spectrum Management and Communications Security (COMSEC)
SFO	Solicitation for Offers
SME	Subject Matter Experts (refer to AHJ)
SMR	Specialized Mobile Radio
SMS	Security Management System
SNMP	Simple Network Management Protocol
SPCC	Security Police Control Center (refer to PCR, SMS)
STP	Shielded Balanced Twisted Pair (refer to UTP)
STR	Stacked Telecommunications Room
TAC	VA's Technology Acquisition Center, Austin, Texas
TCO	Telecommunications Outlet
TER	Telephone Equipment Room
TGB	Telecommunications Grounding Busbar (also Secondary Bonding Busbar (SBB))
TIP	Telecommunications Infrastructure Plant
TMGB	Telecommunications Main Grounding Busbar (also Primary Bonding Busbar (PBB))
TMS	Traffic Management System
TOR	Telephone Operators Room
TP	Balanced Twisted Pair (refer to STP and UTP)
TR	Telecommunications Room (refer to STR)
TWP	Twisted Pair
UHF	Ultra High Frequency (Radio)
UMTS	Universal Mobile Telecommunications System
UPCS	Unlicensed Personal Communications Service (refer to PCS)
UPS	Uninterruptible Power Supply
USC	United States Code
UTP	Unshielded Balanced Twisted Pair (refer to TP and STP)
UV	Ultraviolet



V	Volts
VAAR	Veterans Affairs Acquisition Regulation
VACO	Veterans Affairs Central Office
VAMC	VA Medical Center (refer to CBOC, OPC, VACO)
VCCS	TIP's Vertical Cross Connection System (refer to CCS and HCCS)
VHF	Very High Frequency (Radio)
VISN	Veterans Integrated Services Network (refers to geographical region)
VSWR	Voltage Standing Wave Ratio
W	Watts
WEB	World Electronic Broadcast
WiMAX	Worldwide Interoperability (for MW Access)
WI-FI	Wireless Fidelity
WMTS	Wireless Medical Telemetry Service
WSP	Wireless Service Providers

B. Definitions:

1. Access Floor: Pathway system of removable floor panels supported on adjustable pedestals to allow cable placement in area below.
2. BNC Connector (BNC): United States Military Standard MIL-C-39012/21 bayonet-type coaxial connector with quick twist mating/unmating, and two lugs preventing accidental disconnection from pulling forces on cable.
3. Bond: Permanent joining of metallic parts to form an electrically conductive path to ensure electrical continuity and capacity to safely conduct any currents likely to be imposed to earth ground.
4. Bundled Microducts: All forms of jacketed microducts.
5. Conduit: Includes all raceway types specified.
6. Conveniently Accessible: Capable of being reached without use of ladders, or without climbing or crawling under or over obstacles such as, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.
7. DEMARC, Extended DMARC or ENTR: Service provider's main point of demarcation owned by LEC or service provider and establishes a physical point where service provider's responsibilities for service and maintenance end. This point is called NID, in data networks.
8. Effectively Grounded: Intentionally bonded to earth through connections of low impedance having current carrying capacity to prevent buildup of currents and voltages resulting in hazard to equipment or persons.
9. Electrical Supervision: Analyzing a system's function and components (i.e. cable breaks / shorts, inoperative stations, lights, LEDs and states of change, from primary to backup) on a

- 24/7/365 basis; provide aural and visual emergency notification signals to minimum two remote designated or accepted monitoring stations.
10. Electrostatic Interference (ESI) or Electrostatic Discharge Interference: Refer to EMI and RFI.
  11. Project 25 (2014) (P25 (TIA-102 Series)): Set of standards for local, state and Federal public safety organizations and agencies digital LMR services. P25 is applicable to LMR equipment authorized or licensed under the US Department of Commerce National Telecommunications and Information Administration or FCC rules and regulations, and is a required standard capability for all LMR equipment and systems.
  12. Grounding Electrode Conductor: (GEC) Conductor connected to earth grounding electrode.
  13. Grounding Electrode System: Electrodes through which an effective connection to earth is established, including supplementary, communications system grounding electrodes and GEC.
  14. Grounding Equalizer or Backbone Bonding Conductor (BBC): Conductor that interconnects elements of telecommunications grounding infrastructure.
  15. Head End (HE): Equipment, hardware and software, or a master facility at originating point in a communications system designed for centralized communications control, signal processing, and distribution that acts as a common point of connection between equipment and devices connected to a network of interconnected equipment, possessing greatest authority for allowing information to be exchanged, with whom other equipment is subordinate.
  16. Microducts: All forms of air blown fiber pathways.
  17. Ohm: A unit of restive measurement.
  18. Received Signal Strength Indication (RSSI): A measurement of power present in a received RF signal.
  19. Service Provider Demarcation Point (SPDP): Not owned by LEC or service provider, but designated by Government as point within facility considered the DEMARC.
  20. Sound (SND): Changing air pressure to audible signals over given time span.
  21. System: Specific hardware, firmware, and software, functioning together as a unit, performing task for which it was designed.
  22. Telecommunications Bonding Backbone (TBB): Conductors of appropriate size (minimum 53.49 mm<sup>2</sup> [1/0 AWG]) stranded copper wire, that connect to Grounding Electrode System and route to telecommunications main grounding busbar (TMGB) and circulate to interconnect various TGBs and other locations shown on drawings.
  23. Voice over Internet Protocol (VoIP): A telephone system in which voice signals are converted to packets and transmitted over LAN network using Transmission Control Protocol (TCP)/Internet Protocol (IP). VA'S VoIP is not listed or coded for life and public safety, critical, emergency or other protection functions. When VoIP system or equipment is provided

instead of PBX system or equipment, each TR (STR) and DEMARC requires increased AC power provided to compensate for loss of PBX's telephone instrument line power; and, to compensate for absence of PBX's UPS capability.

24. Wide Area Network (WAN): A digital network that transcends localized LANs within a given geographic location. VA'S WAN/LAN is not nationally listed or coded for life and public safety, critical, emergency or other safety functions.

### 1.3 APPLICABLE PUBLICATIONS

- A. Applicability of Standards: Unless documents include more stringent requirements, applicable construction industry standards have same force and effect as if bound or copied directly into the documents to extent referenced. Such standards are made a part of these documents by reference.
1. Each entity engaged in construction must be familiar with industry standards applicable to its construction activity.
  2. Obtain standards directly from publication source, where copies of standards are needed to perform a required construction activity.
- B. Government Codes, Standards and Executive Orders: Refer to <http://www.cfm.va.gov/TIL/cPro.asp>:
1. Federal Communications Commission, (FCC) CFR, Title 47:

Part 15	Restrictions of use for Part 15 listed RF Equipment in Safety of Life Emergency Functions and Equipment Locations
Part 47	Chapter A, Paragraphs 6.1-6.23, Access to Telecommunications Service, Telecommunications Equipment and Customer Premises Equipment
Part 58	Television Broadcast Service
Part 73	Radio and Television Broadcast Rules
Part 90	Rules and Regulations, Appendix C
Form 854	Antenna Structure Registration
Chapter XXIII	National Telecommunications and Information Administration (NTIA, P/O Commerce, Chapter XXIII) the 'Red Book'– Chapters 7, 8 & 9 compliments CFR, Title 47, FCC Part 15, RF Restriction of Use and Compliance in "Safety of Life" Functions & Locations
  2. US Department of Agriculture, (Title 7, USC, Chapter 55, Sections 2201, 2202 & 2203:RUS 1755 Telecommunications Standards and Specifications for Materials, Equipment and Construction:

RUS Bull 1751F-630	Design of Aerial Cable Plants
RUS Bull 1751F-640	Design of Buried Cable Plant, Physical Considerations
RUS Bull 1751F-643	Underground Plant Design

- |                    |  |
|--------------------|--|
| RUS Bull 1751F-815 | Electrical Protection of Outside Plants,             |
| RUS Bull 1753F-201 | Acceptance Tests of Telecommunications Plants (PC-4) |
| RUS Bull 1753F-401 | Splicing Copper and Fiber Optic Cables (PC-2)        |
| RUS Bull 345-50    | Trunk Carrier Systems (PE-60)                        |
| RUS Bull 345-65    | Shield Bonding Connectors (PE-65)                    |
| RUS Bull 345-72    | Filled Splice Closures (PE-74)                       |
| RUS Bull 345-83    | Gas Tube Surge Arrestors (PE-80)                     |
3. US Department of Commerce/National Institute of Standards Technology,(NIST):
- |                |  |
|----------------|--|
| FIPS PUB 1-1   | Telecommunications Information Exchange  |
| FIPS PUB 100/1 | Interface between Data Terminal Equipment (DTE) Circuit<br>Terminating Equipment for operation with Packet Switched<br>Networks, or Between Two DTEs, by Dedicated Circuit |
| FIPS PUB 140/2 | Telecommunications Information Security Algorithms   |
| FIPS PUB 143   | General Purpose 37 Position Interface between DTE and Data<br>Circuit Terminating Equipment  |
| FIPS 160/2     | Electronic Data Interchange (EDI),   |
| FIPS 175       | Federal Building Standard for Telecommunications Pathway and<br>Spaces   |
| FIPS 191       | Guideline for the Analysis of Local Area Network Security  |
| FIPS 197       | Advanced Encryption Standard (AES)   |
| FIPS 199       | Standards for Security Categorization of Federal Information and<br>Information Systems  |
4. US Department of Defense, (DoD):
- |                 |   |
|-----------------|---|
| MIL-STD-188-110 | Interoperability and Performance Standards for Data Modems  |
| MIL-STD-188-114 | Electrical Characteristics of Digital Interface Circuits  |
| MIL-STD-188-115 | Communications Timing and Synchronizations Subsystems   |
| MIL-C-28883     | Advanced Narrowband Digital Voice Terminals   |
| MIL-C-39012/21  | Connectors, Receptacle, Electrical, Coaxial, Radio Frequency,<br>(Series BNC (Uncabled), Socket Contact, Jam Nut Mounted,<br>Class 2) |
5. US Department of Health and Human Services:  
The Health Insurance Portability and Accountability Act of 1996 (HIPAA) Privacy, Security  
and Breach Notification Rules
6. US Department of Justice:  
2010 Americans with Disabilities Act Standards for Accessible Design (ADAAD).

7. US Department of Labor, (DoL) - Public Law 426-62 – CFR, Title 29, Part 1910, Chapter XVII - Occupational Safety and Health Administration (OSHA), Occupational Safety and Health Standards):
  - Subpart 7                      Approved NRTLs; obtain a copy at  
[http://www.osha.gov/dts/otpc/nrtl/faq\\_nrtl.html](http://www.osha.gov/dts/otpc/nrtl/faq_nrtl.html))
  - Subpart 35                    Compliance with NFPA 101, Life Safety Code
  - Subpart 36                    Design and Construction Requirements for Exit Routes
  - Subpart 268                  Telecommunications
  - Subpart 305                  Wiring Methods, Components, and Equipment for General Use
  - Subpart 508                  Americans with Disabilities Act Accessibility Guidelines; technical requirement for accessibility to buildings and facilities by individuals with disabilities
8. US Department of Transportation, (DoT):
  - a. Public Law 85-625, CFR, Title 49, Part 1, Subpart C – Federal Aviation Administration (FAA):AC 110/460-ID & AC 707 / 460-2E – Advisory Circulars Standards for Construction of Antenna Towers, and 7450 and 7460-2 – Antenna Construction Registration Forms.
9. US Department of Veterans Affairs (VA): Office of Telecommunications (OI&T), MP-6, PART VIII, TELECOMMUNICATIONS, CHAPTER 5, AUDIO, RADIO AND TELEVISION (and COMSEC) COMMUNICATIONS SYSTEMS: Spectrum Management and COMSEC Service (SMCS), AHJ for:
  - a. CoG, “Continuance of Government” communications guidelines and compliance.
  - b. COMSEC, “VA wide coordination and control of security classified communication assets.”
  - c. COOP, “Continuance of Operations” emergency communications guidelines and compliance.
  - d. FAA, FCC, and US Department of Commerce National Telecommunications and Information Administration, “VA wide RF Co-ordination, Compliance and Licensing.”
  - e. Handbook 6100 – Telecommunications: Cyber and Information Security Office of Cyber and Information Security, and Handbook 6500 – Information Security Program.
  - f. Low Voltage Special Communications Systems “Design, Engineering, Construction Contract Specifications and Drawings Conformity, Proof of Performance Testing, VA Compliance and Life Safety Certifications for CFM and VA Facility Low Voltage Special Communications Projects (except Fire Alarm, Telephone and Data Systems).”
  - g. SATCOM, “Satellite Communications” guidelines and compliance, and Security and Law Enforcement Systems – “Coordinates the Design, Engineering, Construction Contract Specifications and Drawings Conformity, Proof of Performance Testing, VA Compliance,

DEA and Public Safety Certification(s) for CFM and VA Facility Security Low Voltage Special Communications and Physical Security Projects.

- h. VHA's National Center for Patient Safety – Veterans Health Administration (VHA) Warning System, Failure of Medical Alarm Systems using Paging Technology to Notify Clinical Staff, July 2004.
  - i. VA's CEOSH, concurrence with warning identified in VA Directive 7700.
  - j. Wireless and Handheld Devices, "Guidelines and Compliance,"
  - k. Office of Security and Law Enforcement: VA Directive 0730 and Health Special Presidential Directive (HSPD)-12.
- C. NRTL Standards: Refer to <https://www.osha.gov/dts/otpca/nrtl/index.html>
- 1. Canadian Standards Association (CSA); same tests as presented by UL
  - 2. Communications Certifications Laboratory (CEL); same tests as presented by UL.
  - 3. Intertek Testing Services NA, Inc., (ITSNA), formerly Edison Testing Laboratory (ETL) same tests as presented by UL).
  - 4. Underwriters Laboratory (UL):
    - 1-2005 Flexible Metal Conduit
    - 5-2011 Surface Metal Raceway and Fittings
    - 6-2007 Rigid Metal Conduit
    - 44-010 Thermoset-Insulated Wires and Cables
    - 50-1995 Enclosures for Electrical Equipment
    - 65-2010 Wired Cabinets
    - 83-2008 Thermoplastic-Insulated Wires and Cables
    - 96-2005 Lightning Protection Components
    - 96A-2007 Installation Requirements for Lightning Protection Systems
    - 360-2013 Liquid-Tight Flexible Steel Conduit
    - 444-2008 Communications Cables
    - 467-2013 Grounding and Bonding Equipment
    - 486A-486B-2013 Wire Connectors
    - 486C-2013 Splicing Wire Connectors
    - 486D-2005 Sealed Wire Connector Systems
    - 486E-2009 Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
    - 493-2007 Thermoplastic-Insulated Underground Feeder and Branch Circuit Cable
    - 497/497A/497B/497C

497D/497E	Protectors for Paired Conductors/Communications Circuits/Data Communications and Fire Alarm Circuits/coaxial circuits/voltage protections/Antenna Lead In
510-2005	Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
514A-2013	Metallic Outlet Boxes
514B-2012	Fittings for Cable and Conduit
514C-1996	Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers
651-2011	Schedule 40 and 80 Rigid PVC Conduit
651A-2011	Type EB and A Rigid PVC Conduit and HDPE Conduit
797-2007	Electrical Metallic Tubing
884-2011	Underfloor Raceways and Fittings
1069-2007	Hospital Signaling and Nurse Call Equipment
1242-2006	Intermediate Metal Conduit
1449-2006	Standard for Transient Voltage Surge Suppressors
1479-2003	Fire Tests of Through-Penetration Fire Stops
1480-2003	Speaker Standards for Fire Alarm, Emergency, Commercial and Professional use
1666-2007	Standard for Wire/Cable Vertical (Riser) Tray Flame Tests
1685-2007	Vertical Tray Fire Protection and Smoke Release Test for Electrical and Fiber Optic Cables
1861-2012	Communication Circuit Accessories
1863-2013	Standard for Safety, communications Circuits Accessories
1865-2007	Standard for Safety for Vertical-Tray Fire Protection and Smoke-Release Test for Electrical and Optical-Fiber Cables
2024-2011	Standard for Optical Fiber Raceways
2024-2014	Standard for Cable Routing Assemblies and Communications Raceways
2196-2001	Standard for Test of Fire Resistive Cable
60950-1 ed. 2-2014	Information Technology Equipment Safety

D. Industry Standards:

1. Advanced Television Systems Committee (ATSC):

A/53 Part 1: 2013	ATSC Digital Television Standard, Part 1, Digital Television System
A/53 Part 2: 2011	ATSC Digital Television Standard, Part 2, RF/Transmission System Characteristics
A/53 Part 3: 2013	ATSC Digital Television Standard, Part 3, Service Multiplex and Transport System Characteristics

- |                   |  |
|-------------------|--|
| A/53 Part 4: 2009 | ATSC Digital Television Standard, Part 4, MPEG-2 Video System Characteristics        |
| A/53 Part 5: 2014 | ATSC Digital Television Standard, Part 5, AC-3 Audio System Characteristics          |
| A/53 Part 6: 2014 | ATSC digital Television Standard, Part 6, Enhanced AC-3 Audio System Characteristics |
2. American Institute of Architects (AIA): 2006 Guidelines for Design & Construction of Health Care Facilities.
  3. American Society of Mechanical Engineers (ASME):
 

A17.1 (2013)	Safety Code for Elevators and Escalators Includes Requirements for Elevators, Escalators, Dumbwaiters, Moving Walks, Material Lifts, and Dumbwaiters with Automatic Transfer Devices
17.3 (2011)	Safety Code for Existing Elevators and Escalators
17.4 (2009)	Guide for Emergency Personnel
17.5 (2011)	Elevator and Escalator Electrical Equipment
  4. American Society for Testing and Materials (ASTM):
 

B1 (2001)	Standard Specification for Hard-Drawn Copper Wire
B8 (2004)	Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
D1557 (2012)	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort 56,000 ft-lbf/ft <sup>3</sup> (2,700 kN-m/m <sup>3</sup> )
D2301 (2004)	Standard Specification for Vinyl Chloride Plastic Pressure Sensitive Electrical Insulating Tape
B258-02 (2008)	Standard Specification for Standard Nominal Diameters and Cross-Sectional Areas of AWG Sizes of Solid Round Wires Used as Electrical Conductors
D709-01(2007)	Standard Specification for Laminated Thermosetting Materials
D4566 (2008)	Standard Test Methods for Electrical Performance Properties of Insulations and Jackets for Telecommunications Wire and Cable
  5. American Telephone and Telegraph Corporation (AT&T) - Obtain following AT&T Publications at <https://ebiznet.sbc.com/SBCNEBS/>:
 

ATT-TP-76200 (2013)	Network Equipment and Power Grounding, Environmental, and Physical Design Requirements
ATT-TP-76300(2012)	Merged AT&T Affiliate Companies Installation Requirements
ATT-TP-76305 (2013)	Common Systems Cable and Wire Installation and Removal Requirements - Cable Racks and Raceways



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|---------------------|---|
| ATT-TP-76306 (2009) | Electrostatic Discharge Control   |
| ATT-TP-76400 (2012) | Detail Engineering Requirements   |
| ATT-TP-76402 (2013) | AT&T Raised Access Floor Engineering and Installation Requirements                        |
| ATT-TP-76405 (2011) | Technical Requirements for Supplemental Cooling Systems in Network Equipment Environments |
| ATT-TP-76416 (2011) | Grounding and Bonding Requirements for Network Facilities                                 |
| ATT-TP-76440 (2005) | Ethernet Specification  |
| ATT-TP-76450 (2013) | Common Systems Equipment Interconnection Standards for AT&T Network Equipment Spaces      |
| ATT-TP-76461 (2008) | Fiber Optic Cleaning  |
| ATT-TP-76900 (2010) | AT&T Installation Testing Requirement   |
| ATT-TP-76911 (1999) | AT&T LEC Technical Publication Notice   |
6. British Standards Institution (BSI):
- |               |  |
|---------------|--|
| BS EN 50109-2 | Hand Crimping Tools - Tools for The Crimp Termination of Electric Cables and Wires for Low Frequency and Radio Frequency Applications – All Parts & Sections. October 1997 |
|---------------|--|
7. Building Industry Consulting Service International(BICSI):
- |                          |  |
|--------------------------|--|
| ANSI/BICSI 002-2011      | Data Center Design and Implementation Best Practices   |
| ANSI/BICSI 004-2012      | Information Technology Systems Design and Implementation Best Practices for Healthcare Institutions and Facilities |
| ANSI/NECA/BICSI 568-2006 | Standard for Installing Commercial Building Telecommunications Cabling   |
| NECA/BICSI 607-2011      | Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings   |
| ANSI/BICSI 005-2013      | Electronic Safety and Security (ESS) System Design and Implementation Best Practices                               |
8. Electronic Components Assemblies and Materials Association,(ECA).
- |                       |  |
|-----------------------|--|
| ECA EIA/RS-270 (1973) | Tools, Crimping, Solderless Wiring Devices – Recommended Procedures for User Certification |
| EIA/ECA 310-E (2005)  | Cabinets, and Associated Equipment   |
9. Facility Guidelines Institute: 2010 Guidelines for Design and Construction of Health Care Facilities.
10. Insulated Cable Engineers Association (ICEA):
- |           |  |
|-----------|--|
| ANSI/ICEA |  |
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|-----------------------|---|
| S-80-576-2002         | Category 1 & 2 Individually Unshielded Twisted-Pair Indoor Cables for Use in Communications Wiring Systems  |
| ANSI/ICEA             |   |
| S-84-608-2010         | Telecommunications Cable, Filled Polyolefin Insulated Copper Conductor, S-87-640(2011) Optical Fiber Outside Plant Communications Cable                           |
| ANSI/ICEA             |   |
| S-90-661-2012         | Category 3, 5, & 5e Individually Unshielded Twisted-Pair Indoor Cable for Use in General Purpose and LAN Communication Wiring Systems                             |
| S-98-688 (2012)       | Broadband Twisted Pair Cable Aircore, Polyolefin Insulated, Copper Conductors   |
| S-99-689 (2012)       | Broadband Twisted Pair Cable Filled, Polyolefin Insulated, Copper Conductors  |
| ICEA S-102-700 (2004) | Category 6 Individually Unshielded Twisted Pair Indoor Cables (With or Without an Overall Shield) for use in Communications Wiring Systems Technical Requirements |
11. Institute of Electrical and Electronics Engineers (IEEE):
- |                                   |  |
|-----------------------------------|--|
| ISSN 0739-5175                    | March-April 2008 Engineering in Medicine and Biology Magazine, IEEE (Volume: 27, Issue:2) Medical Grade-Mission Critical-Wireless Networks |
| IEEE C2-2012                      | National Electrical Safety Code (NESC)   |
| C62.41.2-2002/<br>Cor 1-2012 IEEE | Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits 4)                                   |
| C62.45-2002                       | IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits                      |
| 81-2012 IEEE                      | Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System                                |
| 100-1992                          | IEEE the New IEEE Standards Dictionary of Electrical and Electronics Terms   |
| 602-2007                          | IEEE Recommended Practice for Electric Systems in Health Care Facilities   |
| 1100-2005                         | IEEE Recommended Practice for Powering and Grounding Electronic Equipment  |
12. International Code Council:

- AC193 (2014) Mechanical Anchors in Concrete Elements
13. International Organization for Standardization (ISO):
- ISO/TR 21730 (2007) Use of Mobile Wireless Communication and Computing Technology in Healthcare Facilities - Recommendations for Electromagnetic Compatibility (Management of Unintentional Electromagnetic Interference) with Medical Devices
14. National Electrical Manufacturers Association (NEMA):
- NEMA 250 (2008) Enclosures for Electrical Equipment (1,000V Maximum)
- ANSI C62.61 (1993) American National Standard for Gas Tube Surge Arresters on Wire Line Telephone Circuits
- ANSI/NEMA FB 1 (2012) Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing EMT) and Cable
- ANSI/NEMA OS 1 (2009) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
- NEMA SB 19 (R2007) NEMA Installation Guide for Nurse Call Systems
- TC 3 (2004) Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing
- NEMA VE 2 (2006) Cable Tray Installation Guidelines
15. National Fire Protection Association (NFPA):
- 70E-2015 Standard for Electrical Safety in the Workplace
- 70-2014 National Electrical Code (NEC)
- 72-2013 National Fire Alarm Code
- 75-2013 Standard for the Fire Protection of Information Technological Equipment
- 76-2012 Recommended Practice for the Fire Protection of Telecommunications Facilities
- 77-2014 Recommended Practice on Static Electricity
- 90A-2015 Standard for the Installation of Air Conditioning and Ventilating Systems
- 99-2015 Health Care Facilities Code
- 101-2015 Life Safety Code
- 241 Safeguarding construction, alternation and Demolition Operations
- 255-2006 Standard Method of Test of Surface Burning Characteristics of Building Materials
- 262 - 2011 Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces
- 780-2014 Standard for the Installation of Lightning Protection Systems

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|-----------|---|
| 1221-2013 | Standard for the Installation, Maintenance, and Use of<br>Emergency Services Communications Systems |
| 5000-2015 | Building Construction and Safety Code   |
16. Society for Protective Coatings (SSPC):  
SSPC SP 6/NACE No.3 (2007) Commercial Blast Cleaning
  17. Society of Cable Telecommunications Engineers (SCTE):  
ANSI/SCTE 15 2006 Specification for Trunk, Feeder and Distribution Coaxial Cable
  18. Telecommunications Industry Association (TIA):  
TIA-120 Series Telecommunications Land Mobile communications  
(APCO/Project 25) (January 2014)  
TIA TSB-140 Additional Guidelines for Field-Testing Length, Loss and Polarity  
of Optical Fiber Cabling Systems (2004)  
TIA-155 Guidelines for the Assessment and Mitigation of Installed  
Category 6 Cabling to Support 10GBASE-T (2010)  
TIA TSB-162-A Telecommunications Cabling Guidelines for Wireless Access  
Points (2013)  
TIA-222-G Structural Standard for Antenna Supporting Structures and  
Antennas (2014)  
TIA/EIA-423-B Electrical Characteristics of Unbalanced Voltage Digital Interface  
Circuits (2012)  
TIA-455-C General Requirements for Standard Test Procedures for Optical  
Fibers, Cables, Transducers, Sensors, Connecting and  
Terminating Devices, and other Fiber Optic Components (August  
2014)  
TIA-455-53-A FOTP-53 Attenuation by Substitution Measurements for  
Multimode Graded-Index Optical Fibers in Fiber Assemblies  
(Long Length) (September 2001)  
TIA-455-61-A FOTP-61 Measurement of Fiber of Cable Attenuation Using an  
OTDR (July 2003)  
TIA-472D000-B Fiber Optic Communications Cable for Outside Plant Use (July  
2007)  
ANSI/TIA-492-B 62.5-μ Core Diameter/125-um Cladding Diameter Class 1a  
Graded-Index Multimode Optical Fibers (November 2009)  
ANSI/TIA-492AAAB-A 50-um Core Diameter/125-um Cladding Diameter Class 1A  
Graded-Index Multimode Optically Optimized American Standard  
Fibers (November 2009)

TIA-492CAAA	Detail Specification for Class IVa Dispersion- Unshifted Single-Mode Optical Fibers (September 2002)
TIA-492E000	Sectional Specification for Class IVd Nonzero- Dispersion Single-Mode Optical Fibers for the 1,550 nm Window (September 2002)
TIA-526-7-B	Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant – OFSTP-7 (December 2008)
TIA-526.14-A	Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant – SFSTP-14 (August 1998)
TIA-568	Revision/Edition: C Commercial Building Telecommunications Cabling Standard Set: (TIA-568-C.0-2 Generic Telecommunications Cabling for Customer Premises (2012), TIA-568-C.1-1 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements (2012), TIA-568-C.2 Commercial Building Telecommunications Cabling Standard—Part 2: Balanced Twisted Pair Cabling Components (2009), TIA-568-C.3-1 Optical Fiber Cabling Components Standard, (2011) AND TIA-568-C.4 Broadband Coaxial Cabling and Components Standard (2011) with addendums and erratas
TIA-569	Revision/Edition C Telecommunications Pathways and Spaces (March 2013)
TIA-574	Position Non-Synchronous Interface between Data Terminal equipment and Data Circuit Terminating Equipment Employing Serial Binary Interchange (May 2003)
TIA/EIA-590-A	Standard for Physical Location and Protection of Below Ground Fiber Optic Cable Plant (July 2001)
TIA-598-D	Optical Fiber Cable Color Coding (January 2005)
TIA-604-10-B	Fiber Optic Connector Intermateability Standard (August 2008)
ANSI/TIA-606-B	Administration Standard for Telecommunications Infrastructure (2012)
TIA-607-B	Generic Telecommunications Bonding and Grounding (Earthing) For Customer Premises (January 2013)
TIA-613	High Speed Serial Interface for Data Terminal Equipment and Data Circuit Terminal Equipment (September 2005)
ANSI/TIA-758-B	Customer-owned Outside Plant Telecommunications Infrastructure Standard (April 2012)

ANSI/TIA-854	A Full Duplex Ethernet Specification for 1000 Mb/s (1000BASE-TX) Operating over Category 6 Balanced Twisted-Pair Cabling (2001)
ANSI/TIA-862-A	Building Automation Systems Cabling Standard (April 2011)
TIA-942-A	Telecommunications Infrastructure Standard for Data Centers (March 2014)
TIA-1152	Requirements for Field Testing Instruments and Measurements for Balanced Twisted Pair Cabling (September 2009)
TIA-1179	Healthcare Facility Telecommunications Infrastructure Standard (July 2010)

#### **1.4 SINGULAR NUMBER**

- A. Where any device or part of equipment is referred in singular number (such as " rack"), reference applies to as many such devices as are required to complete installation.

#### **1.5 RELATED WORK**

- A. Specification Order of Precedence: FAR Clause 52.236-21, VAAR Clause 852.236-71.
  - 1. Field Cutting and Patching: Section 09 91 00, PAINTING.
  - 2. Additional submittal requirements: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
  - 3. Closures of openings in walls, floors, and roof decks against penetration of flame, heat, and smoke or gases in fire resistant rated construction: Section 07 84 00, FIRESTOPPING.
  - 4. Sealant and caulking materials and their application: Section 07 92 00, JOINT SEALANTS.
  - 5. General electrical requirements that are common to more than one section of Division 26: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
  - 6. Electrical conductors and cables in electrical systems rated 600 V and below: Section 26 05 19, LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.
  - 7. Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
  - 8. Conduit and boxes: Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
  - 9. Wiring devices: Section 26 27 26, WIRING DEVICES.
  - 10. Alarm initiating devices, alarm notification appliances, control units, fire safety control devices, annunciators, power supplies, and wiring: Section 28 31 00, FIRE DETECTION AND ALARM.

#### **1.6 ADMINISTRATIVE REQUIREMENTS**

- A. Assign a single communications project manager to serve as point of contact for Government, contractor, and design professional.

- B. Be proactive in scheduling work.
  - 1. Use of premises is restricted at times directed by COR.
  - 2. Movement of materials: Unload materials and equipment delivered to site.
  - 3. Coordinate installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
  - 4. Sequence, coordinate, and integrate installations of materials and equipment for efficient flow of Work.
  - 5. Coordinate connection of materials, equipment, and systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies; provide required connection for each service.
  - 6. Initiate and maintain discussion regarding schedule for ceiling construction and install cables to meet that schedule.
- C. Contact the Office of Telecommunications, Special Communications Team (005OP2H3) (202)461-5310 to have a Government-accepted Telecommunications COR assigned to project for telecommunications review, equipment and system approval and coordination with other VA personnel.
- D. Communications Project Manager Responsibilities:
  - 1. Assume responsibility for overall telecommunications system integration and coordination of work among trades, subcontractors, and authorized system installers.
  - 2. Coordinate with related work indicated on drawings or specified.
  - 3. Manage work related to telecommunications system installation in a manner approved by manufacturer.

## **1.7 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Provide parts list including quantity of spare parts.
- C. Provide manufacturer product information. Government reserves the right to require a list of installations where products have been in operation.
- D. Provide Source Quality Control Submittal:
  - 1. Submit written certification from OEM indicating that proposed supervisor of installation and proposed provider of warranty maintenance are authorized representatives of OEM. Include individual's legal name, contact information and OEM credentials in certification.
  - 2. Submit written certification from OEM that wiring and connection diagrams meet Government Life Safety Guidelines, NFPA, NEC, NRTL, these specifications, and Joint Commission requirements and instructions, requirements, recommendations, and guidance set forth by OEM for the proper performance of system.

3. Pre-acceptance Certification: Certification in accordance with procedure outlined in Section 01 00 00, GENERAL REQUIREMENTS and specific Division 27 qualification documentation.
- E. Installer Qualifications: Submit three installations of similar size and complexity furnished and installed by installer; include:
  1. Installation location and name.
  2. Owner's name and contact information including, address, telephone and email.
  3. Date of project start and date of final acceptance.
  4. System project number.
  5. Three paragraph description of each system related to this project; include function, operation, and installation.
- F. Provide delegated design submittals (e.g. seismic support design).
- G. Submittals are required for all equipment anchors and supports. Include weights, dimensions, center of gravity, standard connections, manufacturer's recommendations and behavior problems (e.g., vibration, thermal expansion,) associated with equipment or conduit. Anchors and supports to resist seismic load based on seismic design categories per section 4.0 of VA seismic design requirements H-18-8 dated August, 2013.
- H. Test Equipment List:
  1. Supply test equipment of accuracy better than parameters to be tested.
  2. Submit test equipment list including make and model number:
    - a. ANSI/TIA-1152 Level IV twisted pair cabling test instrument.
    - b. Fiber optic insertion loss power meter with light source.
    - c. Optical time domain reflectometer (OTDR).
    - d. Volt-Ohm meter.
  3. Supply only test equipment with a calibration tag from Government-accepted calibration service dated not more than 12 months prior to test.
  4. Provide sample test and evaluation reports.
- I. Submittal Drawings:
  1. Telecommunications Space Plans/Elevations: Provide enlarged floor plans of telecommunication spaces indicating layout of equipment and devices, including receptacles and grounding provisions. Submit detailed plan views and elevations of telecommunication spaces showing racks, termination blocks, and cable paths. Include following rooms:
    - a. Telecommunications rooms.
    - b. Building Entrance Facility/Demarcation rooms.
    - c. Server rooms/Data Center.
    - d. Equipment rooms.
    - e. Antenna Head End rooms.
  2. Logical Drawings: Provide logical riser or schematic drawings for all systems.



- a. Provide riser diagrams systems and interconnection drawings for equipment assemblies; show termination points and identify wiring connections.
- 3. Access Panel Schedule on Submittal Drawings: Coordinate and prepare a location, size, and function schedule of access panels required to fully service equipment.
- J. Provide sustainable design submittals.
- K. Furnish electronic certified test reports to COR prior to final inspection and not more than 90 days after completion of tests.

## **1.8 CLOSEOUT SUBMITTALS**

- A. Provide following closeout submittals prior to project closeout date:
  - 1. Warranty certificate.
  - 2. Evidence of compliance with requirements such as low voltage certificate of inspection.
  - 3. Project record documents.
  - 4. Instruction manuals and software that are a part of system.
- B. Maintenance and Operation Manuals: Submit in accordance with Section 01 00 00, GENERAL REQUIREMENTS.
  - 1. Prepare a manual for each system and equipment specified.
  - 2. Furnish on portable storage drive in PDF format or equivalent accepted by COR.
  - 3. Furnish complete manual as specified in specification section, fifteen days prior to performance of systems or equipment test.
  - 4. Furnish remaining manuals prior to final completion.
  - 5. Identify storage drive "MAINTENANCE AND OPERATION MANUAL" and system name.
  - 6. Include name, contact information and emergency service numbers of each subcontractor installing system or equipment and local representatives for system or equipment.
  - 7. Provide a Table of Contents and assemble files to conform to Table of Contents.
  - 8. Operation and Maintenance Data includes:
    - a. Approved shop drawing for each item of equipment.
    - b. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of equipment.
    - c. A control sequence describing start-up, operation, and shutdown.
    - d. Description of function of each principal item of equipment.
    - e. Installation and maintenance instructions.
    - f. Safety precautions.
    - g. Diagrams and illustrations.
    - h. Test Results and testing methods.
    - i. Performance data.

- j. Pictorial "exploded" parts list with part numbers. Emphasis to be placed on use of special tools and instruments. Indicate sources of supply, recommended spare parts, and name of servicing organization.
  - k. Warranty documentation indicating end date and equipment protected under warranty.
  - l. Appendix; list qualified permanent servicing organizations for support of equipment, including addresses and certified personnel qualifications.
- C. Record Wiring Diagrams:
- 1. Red Line Drawings: Keep one E size 91.44 cm x 121.92 cm (36 inches x 48 inches) set of floor plans, on site during work hours, showing installation progress marked and backbone cable labels noted. Make these drawings available for examination during construction meetings or field inspections.
  - 2. General Drawing Specifications: Detail and elevation drawings to be D size 61 cm x 91.44 cm (24 inches x 36 inches) with a minimum scale of 0.635 cm = 30.48 cm (1/4 inch = 12 inches). ER, TR and other enlarged detail floor plan drawings to be D size 61 cm x 91.44 cm (24" x 36") with a minimum scale of 0.635 cm = 30.48 cm (1/4 inch = 12 inches). Building composite floor plan drawings to be D size 61 cm x 91.44 cm (24 inches x 36 inches) with a minimum scale of 3.175 mm = 30.48 cm (1/8 inch = 1' 0 inch).
  - 3. Building Composite Floor Plans: Provide building floor plans showing work area outlet locations and configuration, types of jacks, distance for each cable, and cable routing locations.
  - 4. Floor plans to include:
    - a. Final room numbers and actual backbone cabling and pathway locations and labeling.
    - b. Inputs and outputs of equipment identified according to labels installed on cables and equipment
    - c. Device locations with labels.
    - d. Conduit.
    - e. Head-end equipment.
    - f. Wiring diagram.
    - g. Labeling and administration documentation.
  - 5. Submit Record Wiring Diagrams within five business days after final cable testing.
  - 6. Deliver Record Wiring Diagrams as CAD files in .dwg formats as determined by COR.
  - 7. Deliver four complete sets of electronic record wiring diagrams to COR on portable storage drive.
- D. Service Qualifications: Submit name and contact information of service organizations providing service to this installation within four hours of receipt of notification service is needed.

## **1.9 MAINTENANCE MATERIAL SUBMITTALS**

- A. After approval and prior to installation, furnish COR with the following:

1. A 300 mm (12 inch) length of each type and size of wire and cable along with tag from coils of reels from which samples were taken.
2. One coupling, bushing and termination fitting for each type of conduit.
3. Samples of each hanger, clamp and supports for conduit and pathways.
4. Duct sealing compound.

#### **1.10 QUALITY ASSURANCE**

- A. Manufacturer's Qualifications: Manufacturer must produce, as a principal product, the equipment and material specified for this project, and have manufactured item for at least three years.
- B. Product and System Qualification:
  1. OEM must have three installations of equipment submitted presently in operation of similar size and type as this project, that have continuously operated for a minimum of three years.
  2. Government reserves the right to require a list of installations where products have been in operation before approval.
  3. Authorized representative of OEM must be responsible for design, satisfactory operation of installed system, and certification.
- C. Trade Contractor Qualifications: Trade contractor must have completed three or more installations of similar systems of comparable size and complexity with regards to coordinating, engineering, testing, certifying, supervising, training, and documentation. Identify these installations as a part of submittal.
- D. System Supplier Qualifications: System supplier must be authorized by OEM to warranty installed equipment.
- E. Telecommunications technicians assigned to system must be trained, and certified by OEM on installation and testing of system; provide written evidence of current OEM certifications for installers.
- F. Manufactured Products:
  1. Comply with FAR clause 52.236-5 for material and workmanship.
  2. When more than one unit of same class of equipment is required, units must be product of a single manufacturer.
  3. Equipment Assemblies and Components:
    - a. Components of an assembled unit need not be products of same manufacturer.
    - b. Manufacturers of equipment assemblies, which include components made by others, to assume complete responsibility for final assembled unit.
    - c. Provide compatible components for assembly and intended service.
    - d. Constituent parts which are similar must be product of a single manufacturer.
  4. Identify factory wiring on equipment being furnished and on wiring diagrams.
- G. Testing Agencies: Government reserves the option of witnessing factory tests. Notify COR minimum 15 working days prior to manufacturer performing the factory tests.

1. When equipment fails to meet factory test and re-inspection is required, contractor is liable for additional expenses, including expenses of Government.

#### **1.11 DELIVERY, STORAGE, AND HANDLING**

A. Delivery and Acceptance Requirements:

1. Government's approval of submittals must be obtained for equipment and material before delivery to job site.
2. Deliver and store materials to job site in OEM's original unopened containers, clearly labeled with OEM's name and equipment catalog numbers, model and serial identification numbers for COR to inventory cable, patch panels, and related equipment.

B. Storage and Handling Requirements:

1. Equipment and materials must be protected during shipment and storage against physical damage, dirt, moisture, cold and rain:
  - a. Store and protect equipment in a manner that precludes damage or loss, including theft.
  - b. Protect painted surfaces with factory installed removable heavy kraft paper, sheet vinyl or equivalent.
  - c. Protect enclosures, equipment, controls, controllers, circuit protective devices, and other like items, against entry of foreign matter during installation; vacuum clean both inside and outside before testing and operating.

C. Coordinate storage.

#### **1.12 FIELD CONDITIONS**

- A. Where variations from documents are requested in accordance with GENERAL CONDITIONS and Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, connecting work and related components must include additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.
- B. A contract adjustment or additional time will not be granted because of field conditions pursuant to FAR 52.236-2 and FAR 52.236-3; a contract adjustment or additional time will not be granted for additional work required for complete and usable construction and systems pursuant to FAR 52.246-12.

#### **1.13 WARRANTY**

A. Comply with FAR clause 52.246-21, except as follows:

1. Warranty material and equipment to be free from defects, workmanship, and remain so for a period of one year for Emergency Systems from date of final acceptance of system by Government; provide OEM's equipment warranty document to COR.

### **PART 2 - PRODUCTS**

#### **2.1 PERFORMANCE AND DESIGN CRITERIA**

- A. Provide communications spaces and pathways conforming to TIA 569, at a minimum.

## **2.2 EQUIPMENT IDENTIFICATION**

- A. Provide laminated black phenolic resin with a white core nameplates with minimum 6 mm (1/4 inch) high engraved lettering.
- B. Nameplates furnished by manufacturer as standard catalog items, unless other method of identification is indicated.

## **2.3 ACCESS PANELS**

- A. Panels: 304 mm x 304 mm (12 inches by 12 inches), or size allowed by location to provide optimum access to equipment for maintenance and service.
- B. Provide access panels and doors as required to allow service of materials and equipment that require inspection, replacement, repair or service.
- C. Provide access panels where items installed require access and are concealed in floor, wall, furred space or above ceiling; ceilings consisting of lay-in or removable splined tiles do not require access panels.
- D. Provide access panels with same fire rating classification as surface penetrated.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Penetrations and Sleeves:
  - 1. Lay out penetration and sleeve openings in advance, to permit provision in work.
  - 2. Set sleeves in forms before concrete is poured.
  - 3. Set sleeves prior to installation of structure for passage of pipes, conduit, ducts, etc.
  - 4. Provide sleeves and packing materials at penetrations of foundations, walls, slabs, partitions, and floors.
  - 5. Make sleeves that penetrate outside walls, basement slabs, footings, and beams waterproof.
  - 6. Fill slots, sleeves and other openings in floors or walls if not used.
    - a. Fill spaces in openings after installation of conduit or cable.
    - b. Provide fill for floor penetrations to prevent passage of water, smoke, fire, and fumes.
    - c. Provide fire resistant fill in rated floors and walls, to prevent passage of air, smoke and fumes.
  - 7. Install sleeves through floors watertight and extend minimum 50.8 mm (2 inches) above floor surface.
  - 8. Match and set sleeves flush with adjoining floor, ceiling, and wall finishes where raceways passing through openings are exposed in finished rooms.
  - 9. Annular space between conduit and sleeve must be minimum 6 mm (1/4 inch).
  - 10. Do not provide sleeves for slabs-on-grade, unless specified or indicated otherwise.
  - 11. Comply with requirements for firestopping, for sleeves through rated fire walls and smoke partitions.
  - 12. Do not support piping risers or conduit on sleeves.

13. Identify unused sleeves and slots for future installation.
  14. Provide core drilling if walls are poured or otherwise constructed without sleeves and wall penetration is required; do not penetrate structural members.
- B. Core Drilling:
1. Avoid core drilling whenever possible.
  2. Coordinate openings with other trades and utilities, and prevent damage to structural reinforcement.
  3. Investigate existing conditions in vicinity of required opening prior to coring, including an x-ray of floor if determined necessary by competent person or COR.
  4. Protect areas from damage.
- C. Verification of In-Place Conditions:
1. Verify location, use and status of all material, equipment, and utilities that are specified, indicated, or determined necessary for removal.
    - a. Verify materials, equipment, and utilities to be removed are inactive, not required, or in use after completion of project.
    - b. Replace with equivalent any material, equipment and utilities that were removed by contractor that are required to be left in place.
  2. Existing Utilities: Do not interrupt utilities serving facilities occupied by Government or others unless permitted under following conditions and then only after arranging to provide temporary utility services, according to requirements indicated:
    - a. Notify COR in writing at least 14 days in advance of proposed utility interruptions.
    - b. Do not proceed with utility interruptions without Government's written permission.
- D. Provide suspended platforms, strap hangers, brackets, shelves, stands or legs for floor, wall and ceiling mounting of equipment as required.
- E. Provide steel supports and hardware for installation of hangers, anchors, guides, and other support hardware.
- F. Obtain and analyze catalog data, weights, and other pertinent data required for coordination of equipment support provisions and installation.
- G. Verify site conditions and dimensions of equipment to ensure access for proper installation of equipment without disassembly that would void warranty.

### **3.2 INSTALLATION - GENERAL**

- A. Coordinate systems, equipment, and materials installation with other building components.
- B. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings.
- C. Conform to VAAR 852.236.91 arrangements indicated, recognizing that work may be shown in diagrammatic form or have been impracticable to detail all items because of variances in manufacturers' methods of achieving specified results.

- D. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed in both exposed and un-exposed spaces.
- E. Install equipment according to manufacturers' written instructions.
- F. Install wiring and cabling between equipment and related devices.
- G. Install cabling, wiring, and equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum interference of adjacent other installations.
- H. Provide access panel or doors where units are concealed behind finished surfaces.
- I. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for wiring, cabling, and equipment installations.
- J. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide maximum headroom and access for service and maintenance as possible.
- K. Install systems, materials, and equipment giving priority to systems required to be installed at a specified slope.
- L. Avoid interference with structure and with work or other trades, preserving adequate headroom and clearing doors and passageways to satisfaction of COR and code requirements.
- M. Install equipment and cabling to distribute equipment loads on building structural members provided for equipment support under other sections; install and support roof-mounted equipment on structural steel or roof curbs as appropriate.
- N. Provide supplementary or miscellaneous items, appurtenances, devices and materials for a complete installation.

### **3.3 EQUIPMENT INSTALLATION**

- A. Locate equipment as close as practical to locations shown on drawings.
- B. Note locations of equipment requiring access on record drawings.
- C. Access and Access Panels: Verify access panel locations and construction with COR.
- D. Inaccessible Equipment:
  - 1. Where Government determines that contractor has installed equipment not conveniently accessible for operation and maintenance, equipment must be removed and reinstalled as directed and without additional cost to Government.

### **3.4 EQUIPMENT IDENTIFICATION**

- A. Install an identification sign which clearly indicates information required for use and maintenance of equipment.
- B. Secure identification signs with screws.

### **3.5 CUTTING AND PATCHING**

- A. Perform cutting and patching according to contract general requirements and as follows:
  - 1. Remove samples of installed work as specified for testing.

2. Perform cutting, fitting, and patching of equipment and materials required to uncover existing infrastructure in order to provide access for correction of improperly installed existing or new work.
3. Remove and replace defective work.
4. Remove and replace non-conforming work.
- B. Cut, remove, and legally dispose of selected equipment, components, and materials, including removal of material, equipment, devices, and other items indicated to be removed and items made obsolete by new work.
- C. Provide and maintain temporary partitions or dust barriers adequate to prevent spread of dust and dirt to adjacent areas.
- D. Protect adjacent installations during cutting and patching operations.
- E. Protect structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
- F. Patch finished surfaces and building components using new materials specified for original installation and experienced installers.

### **3.6 FIELD QUALITY CONTROL**

- A. Provide work according to VAAR 852.236.91 and FAR clause 52.236-5.
- B. Provide minimum clearances and work required for compliance with NFPA 70, National Electrical Code (NEC), and manufacturers' instructions; comply with additional requirements indicated for access and clearances.
- C. Verify all field conditions and dimensions that affect selection and provision of materials and equipment, and provide any disassembly, reassembly, relocation, demolition, cutting and patching required to provide work specified or indicated, including relocation and reinstallation of existing wiring and equipment.
  1. Protect facility, equipment, and wiring from damage.
- D. Submit written notice that:
  1. Project has been inspected for compliance with documents.
  2. Work has been completed in accordance with documents.
- E. Non-Conforming Work: Conduct project acceptance inspections, final completion inspections, substantial completion inspections, and acceptance testing and demonstrations after verification of system operation and completeness by Contractor.
- F. For project acceptance inspections, final completion inspections, substantial completion inspections, and testing/demonstrations that require more than one site visit by COR or design professional to verify project compliance for same material or equipment, Government reserves right to obtain compensation from contractor to defray cost of additional site visits that result from project construction or testing deficiencies and incompleteness, incorrect information, or non-compliance with project provisions.



1. COR will notify contractor, of hourly rates and travel expenses for additional site visits, and will issue an invoice to Contractor for additional site visits.
2. Contractor is not be eligible for extensions of project schedule or additional charges resulting from additional site visits that result from project construction or testing deficiencies/incompleteness, incorrect information, or non-compliance with Project provisions.

G. Tests:

1. Interim inspection is required at approximately 50 percent of installation.
2. Request inspection ten working days prior to interim inspection start date by notifying COR in writing; this inspection must verify equipment and system being provided adheres to installation, mechanical and technical requirements of construction documents.
3. Inspection to be conducted by OEM and factory-certified contractor representative, and witnessed by COR, facility and SMCS 0050P2H3 representatives.
4. Check each item of installed equipment to ensure appropriate NRTL listing labels and markings are fixed in place.
5. Verify cabling terminations in DEMARC, MCR, TER, SCC, ECC, TRs and head end rooms, workstation locations and TCO adhere to color code for T568B pin assignments and cabling connections are in compliance with TIA standards.
6. Visually confirm minimum Category 6 cable marking at TCOs, CCSs locations, patch cords and origination locations.
7. Review entire communications circulating ground system, each TGB and grounding connection, grounding electrode and outside lightning protection system.
8. Review cable tray, conduit and path/wire way installation practice.
9. OEM and contractor to perform:
  - a. Fiber optical cable field inspection tests via attenuation measurements on factory reels; provide results along with OEM certification for factory reel tests.
  - b. Coaxial cable field inspection tests via attenuation measurements on factory reels; provide results along with OEM certification for factory reel tests.
  - c. Baseband cable field inspection tests via attenuation measurements on factory reels and provide results along with OEM certification for factory reel tests.
10. Relocate failed cable reels to a secured location for inventory, as directed by COR, and then remove from project site within two working days; provide COR with written confirmation of defective cable reels removal from project site.
11. Provide results of interim inspections to COR.
12. If major or multiple deficiencies are discovered, additional interim inspections could be required until deficiencies are corrected, before permitting further system installation.
  - a. Additional inspections are scheduled at direction of COR.

- b. Re-inspection of deficiencies noted during interim inspections, must be part of system's Final Acceptance Proof of Performance Test.
  - c. The interim inspection cannot affect the system's completion date unless directed by COR.
- 13. Facility COR will ensure test documents become a part of system's official documentation package.
- H. Acceptance Test:
  - 1. Schedule an acceptance test date after system has been pretested, and pretest results and certification submitted to COR.
  - 2. Give COR fifteen working days written notice prior to date test is expected to begin; include expected duration of time for test in notification.
  - 3. Test in the presence of the following:
    - a. COR.
    - b. OEM representatives.
    - c. VACO:
      - 1) CFM representative.
      - 2) AHJ-SMCS 005OP2H3, (202)461-5310.
    - d. VISN-CIO, Network Officer and VISN representatives.
    - e. Facility:
      - 1) FMS Service Chief, Bio-Medical Engineering and facility representatives.
      - 2) Ol&T Service Chief and Ol&T representatives.
      - 3) Safety Officer, Police Chief and facility safety representatives.
    - f. Local Community Safety Personnel:
      - 1) Fire Marshal representative.
      - 2) Disaster Coordinator representative.
      - 3) EMS Representatives: Police, Sherriff, City, County or State representatives.
  - 4. Test system utilizing accepted test equipment to certify proof of performance and Life and Public Safety compliance, FCC, NRTL, NFPA and OSHA compliance.
    - a. Rate system as acceptable or unacceptable at conclusion of test; make only minor adjustments and connections required to show proof of performance.
      - 1) Demonstrate and verify that system complies with performance requirements under operating conditions.
      - 2) Failure of any part of system that precludes completion of system testing, and which cannot be repaired within four hours, terminates acceptance test of that portion of system.
      - 3) Repeated failures that result in a cumulative time of eight hours to affect repairs is cause for entire system to be declared unacceptable.

- 4) If system is declared unacceptable, retesting must be rescheduled at convenience of Government and costs borne by the contractor.

I. Acceptance Test Procedure:

1. Physical and Mechanical Inspection: The test team representatives must tour major areas to determine system and sub-systems are completely and properly installed and are ready for acceptance testing.
2. A system inventory including available spare parts must be taken at this time.
3. Each item of installed equipment must be re-checked to ensure appropriate NRTL (i.e. UL) certification listing labels are affixed.
4. Confirm that deficiencies reported during Interim Inspections and Pretesting are corrected prior to start of Acceptance Test.
5. Inventory system diagrams, record drawings, equipment manuals, pretest results.
6. Failure of system to meet installation requirements of specifications is grounds for terminating testing and to schedule re-testing.

J. Operational Test:

1. Government's Condition of Acceptance of System Language:
  - a. Without Acceptance: Until system fully meets conditions of construction documents, system's ownership, use, operation and warranty commences at Government's final acceptance date.
  - b. With Conditional Acceptance: Stating conditions that need to be addressed by contractor or OEM and stating system's use and operation to commence immediately while its warranty commences only at Government's agreed final extended acceptance date.
  - c. With Full Acceptance: Stating system's ownership, use, operation and warranty to immediately commence at Government's agreed to date of final acceptance.

K. Acceptance Test Conclusion: Reschedule testing on deficiencies and shortages with COR, after COR and SMCS AHJ jointly agree to results of the test, using the generated punch list or discrepancy list. Perform retesting to comply with these specifications at contractor's expense.

L. Proof of Performance Certification:

1. If system is declared acceptable, AHJ (SMCS 005OP2H3) provides COR notice stating system processes to required operating standards and functions and is Government accepted for use by facility.
2. Validate items with COR needing to be provided to complete project contract (i.e. charts & diagrams, manuals, spare parts, system warranty documents executed, etc.). Once items have been provided, COR contacts FMS service chief to turn over system from CFM oversight for beneficial use by facility.
3. If system is declared unacceptable without conditions, rescheduled testing expenses are to be borne by contractor.

### **3.7 CLEANING**

- A. Remove debris, rubbish, waste material, tools, construction equipment, machinery and surplus materials from project site and clean work area, prior to final inspection and acceptance of work.
- B. Put building and premises in neat and clean condition.
- C. Remove debris on a daily basis.
- D. Remove unused material, during progress of work.
- E. Perform cleaning and washing required to provide acceptable appearance and operation of equipment to satisfaction of COR.
- F. Clean exterior surface of all equipment, including concrete residue, dirt, and paint residue, after completion of project.
- G. Perform final cleaning prior to project acceptance by COR.
- H. Remove paint splatters and other spots, dirt, and debris; touch up scratches and mars of finish to match original finish.
- I. Clean devices internally using methods and materials recommended by manufacturer.
- J. Tighten wiring connectors, terminals, bus joints, and mountings, to include lugs, screws and bolts according to equipment manufacturer's published torque tightening values for equipment connectors. In absence of published connection or terminal torque values, comply with torque values specified in UL 486A-486B.

### **3.8 TRAINING**

- A. Provide training in accordance with subsection, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.
- B. Provide training for equipment or system as required in each associated specification.
- C. Develop and submit training schedule for approval by COR, at least 30 days prior to planned training.

### **3.9 PROTECTION**

- A. Protection of Fireproofing:
  - 1. Install clips, hangers, clamps, supports and other attachments to surfaces to be fireproofed, if possible, prior to start of spray fireproofing work.
  - 2. Install conduits and other items that would interfere with proper application of fireproofing after completion of spray fire proofing work.
  - 3. Patch and repair fireproofing damaged due to cutting or course of work must be performed by installer of fireproofing and paid for by trade responsible for damage.
- B. Maintain equipment and systems until final acceptance.
- C. Ensure adequate protection of equipment and material during installation and shutdown and during delays pending final test of systems and equipment because of seasonal conditions.

--- E N D ---

**SECTION 27 05 26**  
**GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section identifies common and general grounding and bonding requirements of communication installations and applies to all sections of Divisions 27 and 28 .

**1.2 RELATED WORK**

- A. Low voltage wiring: Section 27 10 00, CONTROL, COMMUNICATION AND SIGNAL WIRING.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- B. Provide plan indicating location of system grounding electrode connections and routing of aboveground and underground grounding electrode conductors.
- C. Closeout Submittals: In addition to Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS provide the following:
1. Certified test reports of ground resistance.
  2. Certifications: Two weeks prior to final inspection, submit following to COR:
    - a. Certification materials and installation is in accordance with construction documents.
    - b. Certification complete installation has been installed and tested.

**PART 2 - PRODUCTS**

**2.1 COMPONENTS**

- A. Grounding and Bonding Conductors:
1. Provide UL 83 insulated stranded copper equipment grounding conductors, with the exception of solid copper conductors for sizes 6 mm<sup>2</sup> (10 AWG) and smaller. Identify all grounding conductors with continuous green insulation color, except identify wire sizes 25 mm<sup>2</sup> (4 AWG) and larger per NEC.
  2. Provide ASTM B8 bare stranded copper bonding conductors, with the exception of ASTM B1 solid bare copper for wire sizes 6 mm<sup>2</sup> (10 AWG) and smaller.
- B. Ground Rods:
1. Copper clad steel, 19 mm (3/4-inch) diameter by 3000 mm (10 feet) long, conforming to UL 467.
  2. Provide quantity of rods required to obtain specified ground resistance.
- C. Splices and Termination Components: Provide components meeting or exceeding UL 467 and clearly marked with manufacturer's name, catalog number, and permitted conductor sizes.
- D. Telecommunication System Ground Busbars:
1. Telecommunications Main Grounding Busbar (TMGB):
    - a. 6.4 mm (1/4 inch) thick solid copper bar.

- b. Minimum 100 mm (4 inches) high and length sized in accordance application requirements and future growth of minimum 510 mm (20 inches) long.
  - c. Minimum thirty predrilled attachment points (two rows of fifteen each) for attaching standard sized two-hole grounding lugs.
    - 1) 27 lugs with 15.8 mm (5/8 inch) hole centers.
    - 2) 3 lugs with 25.4 mm (1 inch) hole centers.
  - d. Wall-mount stand-off brackets, assembly screws and insulators for 100 mm (4 inches) standoff from wall.
  - e. Listed as grounding and bonding equipment.
2. Telecommunications Grounding Busbar (TGB):
- a. 6.4 mm (1/4 inch) thick solid copper bar.
  - b. Minimum 50 mm (2 inches) high and length sized in accordance application requirements and future growth of minimum 300 mm long (12 inches) long.
  - c. Minimum nine predrilled attachment points (one row) for attaching standard sized two-hole grounding lugs.
    - 1) 6 lugs with 15.8 mm (5/8 inch) hole centers.
    - 2) 3 lugs with 25.4 mm (1 inch) hole centers.
  - d. Wall-mount stand-off brackets, assembly screws and insulators for 100 mm (4 inches) standoff from wall.
  - e. Listed as grounding and bonding equipment.
- E. Equipment Rack and Cabinet Ground Bars:
- 1. Solid copper ground bars designed for horizontal mounting to framework of open racks or enclosed equipment cabinets:
    - a. 4.7 mm (3/16 inch) thick by 19.1 mm (3/4 inch) high hard-drawn electrolytic tough pitch 110 alloy copper bar.
    - b. 482 mm (19 inches) or 584 mm (23 inches) EIA/ECA-310-E rack mounting width (as required) for mounting on racks or cabinets.
    - c. Eight 6-32 tapped ground mounting holes on 25.4 mm (1 inch) intervals.
    - d. Four 7.1 mm (0.281 inch) holes for attachment of two-hole grounding lugs.
    - e. Copper splice bar of same material to transition between adjoining racks.
    - f. Two each 12-24 x 19.1 mm (3/4 inch) copper-plated steel screws and flat washers for attachment to rack or cabinet.
    - g. Listed as grounding and bonding equipment.
  - 2. Solid copper ground bars designed for vertical mounting to framework of open racks or enclosed equipment cabinets:
    - a. 1.3 mm (0.05 inch) thick by 17 mm (0.68 inch) wide tinned copper strip.
    - b. 1997 mm (78 inches) high for mounting vertically on full height racks.

- c. Holes punched on 15.875 mm-15.875 mm-12.7 mm (5/8"-5/8"-1/2") alternating vertical centers to match EIA/ECA-310-E Universal Hole Pattern for a 45 RMU rack.
  - d. Three #12-24 zinc-plated thread forming hex washer head installation screws, an abrasive pad and antioxidant joint compound.
  - e. NRTL listed as grounding and bonding equipment.
- F. Ground Terminal Blocks: Provide screw lug-type terminal blocks at equipment mounting location (e.g. backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted.
  - 1. Electroplated tin aluminum extrusion.
  - 2. Accept conductors ranging from #14 AWG through 2/0.
  - 3. Hold conductors in place by two stainless steel set screws.
  - 4. Two 6 mm (1/4 inch) holes spaced on 15.8 mm (5/8 inch) centers to allow secure two-bolt attachment.
  - 5. Listed as a wire connector.
- G. Splice Case Ground Accessories: Provide splice case grounding and bonding accessories manufactured by splice case manufacturer when available. Otherwise, use 16 mm<sup>2</sup> (6 AWG) insulated ground wire with shield bonding connectors.
- H. Irreversible Compression Lugs:
  - 1. Electroplated tinned copper.
  - 2. Two holes spaced on 15.8 mm (5/8 inch) or 25.4 mm (1 inch) centers.
  - 3. Sized to fit the specific size conductor.
  - 4. Listed as wire connectors.
- I. Antioxidant Joint Compound: Oxide inhibiting joint compound for copper-to-copper, aluminum-to-aluminum or aluminum-to-copper connections.

### **PART 3 - EXECUTION**

#### **3.1 EQUIPMENT INSTALLATION AND REQUIREMENTS**

- A. Exterior Equipment Grounding: Bond exterior metallic components (including masts and cabinets), antennas, satellite dishes, towers, raceways, primary telecommunications protector/arresters, secondary surge protection, waveguides, cable shields, down conductors and other conductive items to directly to Intersystem Bonding Termination.
- B. Install telecommunications bonding backbone conductor throughout building via telecommunications backbone pathways effectively bonding all interior telecommunications grounding busbars in telecommunications rooms, to telecommunications main grounding busbar in Demarc room after testing bond to verify bonding conductor for telecommunications from grounding electrode conductor is installed per NEC. Size telecommunications bonding backbone conductor as specified in TIA-607-B.
- C. Inaccessible Grounding Connections: Utilize exothermic welding for bonding of buried or otherwise inaccessible connections with the exception of connections requiring periodic testing.

D. Conduit Systems:

1. Bond ferrous metallic conduit to ground.
2. Bond grounding conductors installed in ferrous metallic conduit at both ends of conduit using grounding bushing with #6 AWG conductor.

E. Boxes, Cabinets, and Enclosures:

1. Bond each pull box, splice box, equipment cabinet, and other enclosures through which conductors pass (except for special grounding systems for intensive care units and other critical units shown) to ground.

F. Corrosion Inhibitors: Apply corrosion inhibitor for protecting connection between metals used to contact surfaces, when making ground and ground bonding connections.

G. Telecommunications Grounding System:

1. Bond telecommunications grounding systems and equipment to facility's electrical grounding electrode at Intersystem Bonding Termination.
2. Provide hardware as required to effectively bond metallic cable shields communications pathways, cable runway, and equipment chassis to ground.
3. Install bonding conductors without splices using shortest length of conductor possible to maintain clearances required by NEC.
4. Provide paths to ground that are permanent and continuous with a resistance of 1 ohm or less from each raceway, cable tray, and equipment connection to telecommunications grounding busbar.
5. Below-Grade Connections: When making exothermic welds, wire brush or file the point of contact to a bare metal surface. Use exothermic welding cartridges and molds in accordance with manufacturer's recommendations. After welds have been made and cooled, brush slag from weld area and thoroughly clean joint areas. Notify COR prior to backfilling at ground connections.
6. Above-Grade Bolted or Screwed Grounding Connections:
  - a. Remove paint to expose entire contact surface by grinding.
  - b. Clean all connector, plate and contact surfaces.
  - c. Apply corrosion inhibitor to surfaces before joining.
7. Bonding Jumpers:
  - a. Assemble bonding jumpers using insulated ground wire of size and type shown on drawings or use a minimum of 16 mm<sup>2</sup> (6 AWG) insulated copper wire terminated with compression connectors of proper size for conductors.
  - b. Use connector manufacturer's compression tool.
8. Bonding Jumper Fasteners:



- a. Conduit: Connect bonding jumpers using lugs on grounding bushings or clamp pads on push-type conduit fasteners. Where appropriate, use zinc-plated external tooth lockwashers or Belleville Washers.
  - b. Wireway and Cable Tray: Fasten bonding jumpers using zinc-plated bolts, external tooth lockwashers or Belleville washers and nuts. Install protective cover, e.g., zinc-plated acorn nuts, on bolts extending into wireway or cable tray to prevent cable damage.
  - c. Grounding Busbars: Fasten bonding conductors using two-hole compression lugs. Use 300 series stainless steel bolts, Belleville Washers, and nuts.
  - d. Slotted Channel Framing and Raised Floor Stringers: Fasten bonding jumpers using zinc-plated, self-drill screws and Belleville washers or external tooth lock washers.
- H. Telecommunications Room Bonding:
1. Telecommunications Grounding Busbars:
    - a. Install busbar hardware no less than 950 mm (18 inches) A.F.F.
    - b. Where other grounding busbars are located in same room, e.g. electrical panelboard for telecommunications equipment, bond busbars together as indicated on grounding riser diagrams.
    - c. Make conductor connections with two-hole compression lugs sized to fit busbar and conductors.
    - d. Attach lugs with stainless steel hardware after preparing bond according to manufacturer recommendations and treating bonding surface on busbar with anti-oxidant to help prevent corrosion.
  2. Telephone-Type Cable Rack Systems:
    - a. Aluminum pan installed on telephone-type cable rack serves as primary ground conductor within communications room.
    - b. Make ground connections by installing bonding jumpers:
      - 1) Install minimum 16 mm<sup>2</sup> (6 AWG) bonding between telecommunications ground busbars and the aluminum pan installed on cable rack.
      - 2) Install 16 mm<sup>2</sup> (6 AWG) bonding jumpers across aluminum pan junctions.
- I. Self-Supporting and Cabinet-Mounted Equipment Rack Ground Bars:
1. Install rack-mount horizontal busbar or vertical busbar to provide multiple bonding points,
  2. At each rack or cabinet containing active equipment or shielded cable terminations:
    - a. Bond busbar to ground as part of overall telecommunications bonding and grounding system.
    - b. Bond copper ground bars together using solid copper splice plates manufactured by same ground bar manufacturer, when ground bars are provided at rear of lineup of bolted together equipment racks.

- c. Bond non-adjacent ground bars on equipment racks and cabinets with 16 mm<sup>2</sup> (6 AWG) insulated copper wire bonding jumpers attached at each end with compression-type connectors and mounting bolts.
  - d. Provide 16 mm<sup>2</sup> (6 AWG) bonding jumpers between rack and cabinet ground busbars and overhead cable runway or raised floor stringers, as appropriate.
- J. Backboards: Provide a screw lug-type terminal block or drilled and tapped copper strip near top of backboards used for communications cross-connect systems. Connect backboard ground terminals to cable runway using an insulated 16 mm<sup>2</sup> (6 AWG) bonding jumper.
- K. Other Communication Room Ground Systems: Ground metallic conduit, wireways, and other metallic equipment located away from equipment racks or cabinets to cable tray or telecommunications ground busbar, whichever is closer, using insulated 16 mm<sup>2</sup> (6 AWG) ground wire bonding jumpers.
- L. Communications Cable Grounding:
  - 1. Bond all metallic cable sheaths in multi-pair communications cables together at each splicing or terminating location to provide 100 percent metallic sheath continuity throughout communications distribution system.
  - 2. Install a cable shield bonding connector with a screw stud connection for ground wire, at terminal points. Bond cable shield connector to ground.
  - 3. Bond all metallic cable shields together within splice closures using cable shield bonding connectors or splice case manufacturer's splice case grounding and bonding accessories. When an external ground connection is provided as part of splice closure, connect to an effective ground source and bond all other metallic components and equipment at that location.
- M. Communications Cable Tray Systems:
  - 1. Bond metallic structures of cable tray to provide 100 percent electrical continuity throughout cable tray systems.
  - 2. Where metallic cable tray systems are mechanically discontinuous:
    - a. Install splice plates provided by cable tray manufacturer between cable tray sections so resistance across a bolted connection is 0.010 ohms or less, as verified by measuring across splice plate connection.
    - b. Install 16 mm<sup>2</sup> (6 AWG) bonding jumpers across each cable tray splice or junction where splice plates cannot be used.
  - 3. Bond cable tray installed in same room as telecommunications grounding busbar to busbar.
- N. Communications Raceway Grounding:
  - 1. Conduit: Use insulated 16 mm<sup>2</sup> (6 AWG) bonding jumpers to bond metallic conduit at both ends and intermediate metallic enclosures to ground.

2. Cable Tray Systems: Use insulated 16 mm<sup>2</sup> (6 AWG) grounding jumpers to bond cable tray to column-mounted building ground plates (pads) at both ends and approximately 16 meters (50 feet) on centers.
- O. Ground Resistance:
1. Install telecommunications grounding system so resistance to grounding electrode system measures 5 ohms or less.
  2. Measure grounding electrode system resistance using an earth test meter, clamp-on ground tester, or computer-based ground meter as defined in IEEE 81. Record ground resistance measurements before electrical distribution system is energized.
  3. Backfill only after below-grade connection have been visually inspected by COR. Notify COR twenty-four hours before below-grade connections are ready for inspection.

### **3.2 FIELD QUALITY CONTROL**

- A. Perform tests per BICSI's Information Technology Systems Installation Methods Manual (ITSIMM), Recommended Testing Procedures and Criteria.
- B. Perform two-point bond test using trained installers qualified to use test equipment.
- C. Conduct continuity test to verify that metallic pathways in telecommunications spaces are bonded to TGB or TMGB.
- D. Conduct electrical continuity test to verify that TMGB is effectively bonded to grounding electrode conductor.
- E. Visually inspect to verify that screened and shielded cables are bonded to TGB or TMGB.
- F. Perform a resistance test to ensure patch panel, rack and cabinet bonding connection resistance measures less than 5 Ohms to TGB or TMGB.

--- E N D ---

**SECTION 27 05 33**  
**RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies conduit, fittings, and boxes to form complete, coordinated, raceway systems. Raceways are required for communications cabling unless shown or specified otherwise.

**1.2 RELATED WORK**

- A. Mounting board for Telecommunication Rooms: Section 06 10 00, ROUGH CARPENTRY.
- B. Sealing around penetrations to maintain integrity of fire rated construction: Section 07 84 00, FIRESTOPPING.
- C. Fabrications for deflection of water away from building envelope at penetrations: Section 07 60 00, FLASHING AND SHEET METAL.
- D. Sealing around conduit penetrations through building envelope to prevent moisture migration into building: Section 07 92 00, JOINT SEALANTS.
- E. Identification and painting of conduit and other devices: Section 09 91 00, PAINTING.
- F. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

**1.3 SUBMITTALS**

- A. In accordance with Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS, submit the following:
  - 1. Size and location of cabinets, splice boxes and pull boxes.
  - 2. Layout of required conduit penetrations through structural elements.
  - 3. Catalog cuts marked with specific item proposed and area of application identified.
- B. Certification: Provide letter prior to final inspection, certifying material is in accordance with construction documents and properly installed.

**PART 2 - PRODUCTS**

**2.1 MATERIAL**

- A. Minimum Conduit Size: 19 mm (3/4 inch).
- B. Conduit:
  - 1. Rigid Galvanized Steel: Conform to UL 6, ANSI C80.1.
  - 2. Rigid Aluminum: Conform to UL 6A, ANSI C80.5.
  - 3. Rigid Intermediate Steel Conduit (IMC): Conform to UL 1242, ANSI C80.6.
  - 4. Electrical Metallic Tubing (EMT):
    - a. Maximum Size: 105 mm (4 inches).
    - b. Install only for cable rated 600 volts or less.
    - c. Conform to UL 797, ANSI C80.3.

5. Flexible Galvanized Steel Conduit: Conform to UL 1.
6. Liquid-tight Flexible Metal Conduit: Conform to UL 360.
7. Direct Burial Plastic Conduit: Conform to UL 651 and UL 651A, heavy wall PVC, or high density polyethylene (HDPE).
8. Surface Metal Raceway: Conform to UL 5.
9. Wireway, Approved "Basket": Provide "Telecommunications Service" rated with approved length way partitions and cable straps to prevent wires and cables from changing from one partitioned pathway to another.

C. Conduit Fittings:

1. Rigid Galvanized Steel and Rigid Intermediate Steel Conduit Fittings:
  - a. Provide fittings meeting requirements of UL 514B and ANSI/ NEMA FB 1.
  - b. Sealing: Provide threaded cast iron type. Use continuous drain type sealing fittings to prevent passage of water and vapor. In concealed work, install sealing fittings in flush steel boxes with blank cover plates having same finishes as other electrical plates in room.
  - c. Standard Threaded Couplings, Locknuts, Bushings, and Elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
  - d. Locknuts: Bonding type with sharp edges for digging into metal wall of an enclosure.
  - e. Bushings: Metallic insulating type, consisting of an insulating insert molded or locked into metallic body of fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
  - f. Erickson (union-type) and Set Screw Type Couplings:
    - 1) Couplings listed for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete.
    - 2) Use set screws of case hardened steel with hex head and cup point to seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
  - g. Provide OEM approved fittings.
2. Rigid Aluminum Conduit Fittings:
  - a. Standard Threaded Couplings, Locknuts, Bushings, and Elbows: Malleable iron, steel or aluminum alloy materials; Zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 percent copper are not permitted.
  - b. Locknuts and Bushings: As specified for rigid steel and IMC conduit.
  - c. Set Screw Fittings: Not permitted for use with aluminum conduit.
3. Electrical Metallic Tubing Fittings:
  - a. Conform to UL 514B and ANSI/ NEMA FB1; only steel or malleable iron materials are acceptable.

- b. Couplings and Connectors: Concrete tight and rain tight, with connectors having insulated throats.
  - 1) Use gland and ring compression type couplings and connectors for conduit sizes 50 mm (2 inches) and smaller.
  - 2) Use set screw type couplings with four set screws each for conduit sizes over 50 mm (2 inches).
  - 3) Use set screws of case-hardened steel with hex head and cup point to seat in wall of conduit for positive grounding.
- c. Indent type connectors or couplings are not permitted.
- d. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are not permitted.
- e. Provide OEM approved fittings.
- 4. Flexible Steel Conduit Fittings:
  - a. Conform to UL 514B; only steel or malleable iron materials are acceptable.
  - b. Provide clamp type, with insulated throat.
  - c. Provide OEM approved fittings.
- 5. Liquid-tight Flexible Metal Conduit Fittings:
  - a. Conform to UL 514B and ANSI/ NEMA FB1; only steel or malleable iron materials are acceptable.
  - b. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening.
  - c. Provide connectors with insulated throats to prevent damage to cable jacket.
  - d. Provide OEM approved fittings.
- 6. Direct Burial Plastic Conduit Fittings: Provide fittings meeting requirements of UL 514C and NEMA TC3, and as recommended by conduit manufacturer.
- 7. Surface Metal Raceway: Conform to UL 5 and "telecommunications service" rated with approved length-way partitions and cable straps to prevent wires and cables from changing from one partitioned pathway to another.
- 8. Surface Metal Raceway Fittings: As recommended by raceway manufacturer.
- 9. Expansion and Deflection Couplings:
  - a. Conform to UL 467 and UL 514B.
  - b. Accommodate 19 mm (3/4 inch) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
  - c. Include internal flexible metal braid sized to ensure conduit ground continuity and fault currents in accordance with UL 467, and NEC code tables for ground conductors.
  - d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.

10. Rigid Aluminum Fittings:
  - a. Provide malleable iron, steel or aluminum alloy materials; zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 percent copper are prohibited.
  - b. Locknuts and Bushings: As specified for rigid steel and IMC conduit.
  - c. Set Screw Fittings: Not permitted for use with aluminum conduit.
  - d. Indent type connectors or couplings are prohibited.
  - e. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are not permitted.
  - f. Provide OEM approved fittings.
11. Wireway Fittings: As recommended by wireway OEM.
- D. Conduit Supports:
  1. Parts and Hardware: Provide zinc-coat or equivalent corrosion protection.
  2. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
  3. Multiple Conduit (Trapeze) Hangers: Minimum 38 mm by 38 mm (1-1/2 by 1-1/2 inch), 2.78 mm (12 gage) steel, cold formed, lipped channels; with minimum 9 mm (3/8 inch) diameter steel hanger rods.
  4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.
- E. Outlet, Splice, and Pull Boxes:
  1. Conform to UL-50 and UL-514A.
  2. Cast metal where required by NEC or shown, and equipped with rustproof boxes.
  3. Sheet Metal Boxes: Galvanized steel, except where otherwise shown.
  4. Install flush mounted wall or ceiling boxes with raised covers so that front face of raised cover is flush with wall.
  5. Install surface mounted wall or ceiling boxes with surface style flat or raised covers.
- F. Wireways: Equip with hinged covers, except where removable covers are shown.
- G. Warning Tape: Standard, 4-Mil polyethylene 76 mm (3 inch) wide tape detectable type, red with black letters, and imprinted with "CAUTION BURIED COMMUNICATIONS CABLE BELOW".
- H. Flexible Nonmetallic Communications Raceway (Innerduct) and Fittings:
  1. General: Provide UL 910 listed plenum, riser, and general purpose corrugated pliable communications raceway for optical fiber cables and communications cable applications; select in accordance with provisions of NEC Articles 770 and 800.
  2. Provide Communications Raceway with a factory installed 567 kg (1250 lb.) tensile pre-lubricated pull tape.
  3. Use only metallic straps, hangers and fittings to support raceway from building structure. Cable ties are not permitted for securing raceway to building structure.

4. Provide fittings to be installed in spaces used for environmental air made of materials that do not exceed flammability, smoke generation, ignitability, and toxicity requirements of environmental air space.
5. Size: Metric Designator 53 (trade size 2) or smaller.
6. Outside Plant: Plenum-rated where each interduct is 75 mm (3 inches) and larger.
7. Inside Plant: Listed and marked for installation in plenum airspaces and minimum 25 mm (1 inch) inside diameter.
8. Plenum: Non-metallic communications raceway.
  - a. Constructed of low smoke emission, flame retardant PVC with corrugated construction.
  - b. UL 94 V-O rating for flame spreading limitation.
9. Provide innerduct reel lengths as necessary to ensure ducts are continuous; one piece runs from ENTR to MH; MH to MH; DEMARC to MCR/TER; TR to TR. Innerduct connectors are not permitted between rooms.
10. Provide pulling accessories used for innerduct including but not limited to, inner duct lubricants, spreaders, applicators, grips, swivels, harnesses, and line missiles (blown air) compatible with materials being pulled.
- I. Outlet Boxes:
  1. Flush wall mounted minimum 11.9 cm (4-11/16 inches) square, 9.2 cm (3-5/8 inches) deep pressed galvanized steel.
  2. Flush wall mounted 12.7 cm (5 inches) square x 7.3 cm (2-7/8 inches); deep pressed galvanized steel.
  3. 2-Gang Tile Box:
    - a. Flush backbox type for installation in block walls.
    - b. Minimum 92 mm (3-5/8 inches) deep.
- J. Weatherproof Outlet Boxes: Surface mount two gang, 67 mm (2-5/8 inches) deep weatherproof cast aluminum with powder coated finish internal threads on hubs 19 mm (3/4 inch) minimum.
- K. Cable Tray:
  1. Provide wire basket type of sizes indicated; with all required splicing and mounting hardware.
  2. Materials and Finishes:
    - a. Electro-plated zinc galvanized (post plated) made from carbon steel and plated to ASTM B 633, Type III, SC-1.
    - b. Remove soot, manufacturing residue/oils, or metallic particles after fabrication.
    - c. Rounded edges and smooth surfaces.
  3. Provide continuous welded top side wire to protect cable insulation and installers.
  4. High strength steel wires formed into a 50 x 100 mm (2 inches by 4 inches) wire mesh pattern with intersecting wires welded together.
  5. Wire Basket Sizes:



- a. Wire Diameter: 5 mm (0.195 inch) minimum on all mesh sections.
- b. Usable Loading Depth: 150 mm (6 inches).
- c. Width: 300 mm (12 inches) 450 mm (18 inches).
- 6. Fittings: Field-formed, from straight sections, in accordance with manufacturer's instructions.
- 7. Provide accessories to protect, support and install wire basket tray system.
- L. Cable Duct: Equip with hinged covers, except where removable covers are accepted by COR.
- M. Cable Duct Fittings: As recommended by cable duct OEM.

### PART 3 - EXECUTION

#### 3.1 EQUIPMENT INSTALLATION AND REQUIREMENTS

- A. Raceways typically required for cabling systems unless otherwise indicated:

System	Specification Section	Installed Method
Grounding	27 05 26	Conduit Not Required
Control, Communication and Signal Wiring	27 10 00	Complete Conduit Allowed in Non-Partitioned Cable Tray or Cable Ladders
Communications Structured Cabling	27 15 00	Conduit to Cable Tray Partitioned Cable Tray
Master Antenna Television Equipment and Systems	27 41 31	J-Hooks, Bridle Rings, conduit to Cable Tray, Partitioned Cable Tray
Nurse Call	27 52 23	Complete Conduit
Grounding and Bonding for Electronic Safety and Security	28 05 26	Conduit Not Required Unless Required by Code
Physical Access Control System	28 13 00	Conduit to Cable Tray Partitioned Cable Tray
Video Surveillance	28 23 00	Complete Conduit
Fire Detection and Alarm	28 31 00	Complete Conduit

- B. Penetrations:

1. Cutting or Holes:

- a. Locate holes in advance of installation. Where they are proposed in structural sections, obtain approval of structural engineer and COR prior to drilling through structural sections.
- b. Make holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not permitted; COR may grant limited permission by request, in condition of limited working space.
- c. Fire Stop: Where conduits, wireways, and other communications raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an

effective barrier against spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING.

- 1) Fill and seal clearances between raceways and openings with fire stop material.
- 2) Install only retrofittable, non-hardening, and reusable firestop material that can be removed and reinstalled to seal around cables inside conduits.

d. Waterproofing at Floor, Exterior Wall, and Roof Conduit Penetrations:

- 1) Seal clearances around conduit and make watertight as specified in Section 07 92 00, JOINT SEALANTS or directed by waterproofing manufacturer.

C. Conduit Installation:

1. Minimum conduit size of 19 mm (3/4 inch), but not less than size required for 40 percent fill.
2. Install insulated bushings on all conduit ends.
3. Install pull boxes after every 180 degrees of bends (two 90 degree bends). Size boxes per TIA 569.
4. Extend vertical conduits/sleeves through floors minimum 75 mm (3 inches) above floor and minimum 75 mm (3 inches) below ceiling of floor below.
5. Terminate conduit runs to and from a backboard in a closet or interstitial space at top or bottom of backboard. Install conduits to enter telecommunication rooms next to wall and flush with backboard.
6. Where drilling is necessary for vertical conduits, locate holes so as not to affect structural sections.
7. Seal empty conduits located in telecommunications rooms or on backboards with a standard non-hardening putty compound to prevent entrance of moisture and gases and to meet fire resistance requirements.
8. Minimum radius of communication conduit bends:

Sizes of Conduit Trade Size	Radius of Conduit Bends mm, Inches
3/4	150 (6)
1	230 (9)
1-1/4	350 (14)
1-1/2	430 (17)
2	525 (21)
2-1/2	635 (25)
3	775 (31)
3-1/2	900 (36)
4	1125 (45)

9. Provide 19 mm (3/4 inch) thick fire retardant plywood specified in Section 06 10 00, ROUGH CARPENTRY on wall of communication closets where shown on drawings. Mount plywood

with bottom edge 300 mm (12 inches) above finished floor and top edge 2.74 m (9 feet)

A.F.F.

10. Provide pull wire in all empty conduits; sleeves through floor are exceptions.
  11. Complete each entire conduit run installation before pulling in cables.
  12. Flattened, dented, or deformed conduit is not permitted.
  13. Ensure conduit installation does not encroach into ceiling height head room, walkways, or doorways.
  14. Cut conduit square with a hacksaw, ream, remove burrs, and draw tight.
  15. Install conduit mechanically continuous.
  16. Independently support conduit at 2.44 m (8 feet) on center; do not use other supports (i.e., suspended ceilings, suspended ceiling supporting members, luminaires, conduits, mechanical piping, or mechanical ducts).
  17. Support conduit within 300 mm (1 foot) of changes of direction, and within 300 mm (1 foot) of each enclosure to which connected.
  18. Close ends of empty conduit with plugs or caps to prevent entry of debris, until cables are pulled in.
  19. Attach conduits to cabinets, splice cases, pull boxes and outlet boxes with bonding type locknuts. For rigid and IMC conduit installations, provide a locknut on inside of enclosure, made up wrench tight. Do not make conduit connections to box covers.
  20. Do not use aluminum conduits in wet locations.
  21. Unless otherwise indicated on drawings or specified herein, conceal conduits within finished walls, floors and ceilings.
  22. Conduit Bends:
    - a. Make bends with standard conduit bending machines; observe minimum bend radius for cable type and outside diameter.
    - b. Conduit hickey is permitted only for slight offsets, and for straightening stubbed conduits.
    - c. Bending of conduits with a pipe tee or vise is not permitted.
  23. Layout and Homeruns - Deviations: Make only where necessary to avoid interferences and only after drawings showing proposed deviations have been submitted and approved by COR.
- D. Furred or Suspended Ceilings and in Walls:
1. Rigid steel, IMC or rigid aluminum. Different type conduits mixed indiscriminately in same system is not permitted.
  2. Align and run conduit parallel or perpendicular to building lines.
  3. Tightening set screws with pliers is not permitted.
- E. Exposed Work Installation:

1. Unless otherwise indicated on drawings, exposed conduit is only permitted in telecommunications rooms.
    - a. Provide rigid steel, IMC or rigid aluminum.
    - b. Different type of conduits mixed indiscriminately in system is not permitted.
  2. Align and run conduit parallel or perpendicular to building lines.
  3. Install horizontal runs close to ceiling or beams and secure with conduit straps.
  4. Support horizontal or vertical runs at not over 2400 mm (96 inches) intervals.
  5. Surface Metal Raceways: Use only where shown on drawings.
  6. Painting:
    - a. Paint exposed conduit as specified in Section 09 91 00, PAINTING.
    - b. Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color.
    - c. Provide labels where conduits pass through walls and floors and at maximum 6000 mm (20 foot) intervals in between.
- F. Expansion Joints:
1. Conduits 75 mm (3 inches) and larger, that are secured to building structure on opposite sides of a building expansion joint, require expansion and deflection couplings. Install couplings in accordance with manufacturer's recommendations.
  2. Provide conduits smaller than 75 mm (3 inches) with pull boxes on both sides of expansion joint. Connect conduits to expansion and deflection couplings as specified.
  3. Install expansion and deflection couplings where shown.
- G. Not Used
- H. Conduit Supports, Installation:
1. Select AC193 code listed mechanical anchors or fastening devices with safe working load not to exceed 1/4 of proof test load.
  2. Use pipe straps or individual conduit hangers for supporting individual conduits. Maximum distance between supports is 2.5 m (8 foot) on center.
  3. Support multiple conduit runs with trapeze hangers. Use trapeze hangers designed to support a load equal or greater than sum of the weights of the conduits, wires, hanger itself, and 90 kg (200 pounds). Attach each conduit with U-bolts or other accepted fasteners.
  4. Support conduit independent of pull boxes, luminaires, suspended ceiling components, angle supports, duct work, and similar items.
  5. Fastenings and Supports in Solid Masonry and Concrete:
    - a. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing concrete.
    - b. Existing Construction:
      - 1) Code AC193 listed wedge type steel expansion anchors minimum 6 mm (1/4 inch) bolt size and minimum 28 mm (1-1/8 inch) embedment.

- 2) Power set fasteners minimum 6 mm (1/4 inch) diameter with depth of penetration minimum 75 mm (3 inches).
- 3) Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.
6. Fastening to Hollow Masonry: Toggle bolts are permitted.
7. Fastening to Metal Structures: Use machine screw fasteners or other devices designed and accepted for application.
8. Bolts supported only by plaster or gypsum wallboard are not acceptable.
9. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.
10. Do not support conduit from chain, wire, or perforated strap.
11. Spring steel type supports or fasteners are not permitted except horizontal and vertical supports/fasteners within walls.
12. Vertical Supports:
  - a. Install riser clamps and supports for vertical conduit runs in accordance with NEC.
  - b. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.
- I. Box Installation:
  1. Boxes for Concealed Conduits:
    - a. Flush mounted.
    - b. Provide raised covers for boxes to suit wall or ceiling, construction and finish.
  2. In addition to boxes shown, install additional boxes where needed to prevent damage to cables during pulling.
  3. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.
  4. Stencil or install phenolic nameplates on covers of boxes identified on riser diagrams; for example "SIG-FA JB No. 1".
  5. Outlet boxes mounted back-to-back in same wall are not permitted. A minimum 600 mm (24 inches) center-to-center lateral spacing must be maintained between boxes.
- J. Flexible Nonmetallic Communications Raceway (Innerduct), Installation:
  1. Install supports from building structure for horizontal runs at intervals not to exceed 900 mm (3 feet) and at each end.
  2. Install supports from building structure for vertical runs at intervals not to exceed 1.2 m (4 feet) and at each side of joints.
  3. Install only in accessible spaces not subject to physical damage or corrosive influences.
  4. Make bends manually to assure internal diameter of tubing is not effectively reduced.

5. Extend each segment of innerduct minimum 300 mm (12 inches) beyond end of service conduit tie or cable tray. Restrain innerduct ends with wall mount clamps and seal when cable is installed.

### **3.2 TESTING**

- A. Examine fittings and locknuts for secureness.
- B. Test RMC, IMC and EMT systems for electrical continuity.
- C. Perform simple continuity test after cable installation.

--- E N D ---

**SECTION 27 15 00**  
**COMMUNICATIONS STRUCTURED CABLING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies a complete and operating voice and digital structured cabling distribution system and associated equipment and hardware to be installed in VA Medical Center, here-in-after referred to as the "facility".

**1.2 RELATED WORK**

- A. Wiring devices: Section 26 27 26, WIRING DEVICES.
- B. General electrical requirements that are common to more than one section in Division 27: Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- C. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.
- D. Conduits for cables and wiring: Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.

**1.3 SUBMITTALS**

- A. In addition to requirements of Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS provide:
  - 1. List of test equipment as per 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- B. Certifications:
  - 1. Submit written certification from OEM indicating that proposed supervisor of installation and proposed provider of contract maintenance are authorized representatives of OEM. Include individual's legal name and address and OEM warranty credentials in the certification.
  - 2. Pre-acceptance Certification: Submit in accordance with test procedures.
  - 3. Test system cables and certify to COR before proof of performance testing can be conducted. Identify each cable as labeled on as-installed drawings.
  - 4. Provide current and qualified test equipment OEM training certificates and product OEM installation certification for contractor installation, maintenance, and supervisory personnel.
- C. Closeout Submittal: Provide document from OEM certifying that each item of equipment installed conforms to OEM published specifications.

**1.4 WARRANTY**

- A. Work subject to terms of Article "Warranty of Construction," FAR clause 52.246-21.

**PART 2 - PRODUCTS**

**2.1 PERFORMANCE AND DESIGN CRITERIA**

- A. Provide complete system including "punch down" and cross-connector blocks voice and data distribution sub-systems, and associated hardware including telecommunications outlets (TCO);

copper and fiber optic distribution cables, connectors, "patch" cables, "break out" devices and equipment cabinets, interface cabinets, and radio relay equipment rack.

B. Industry Standards:

1. Cable distribution systems provided under this section are connected to systems identified as critical care performing life support functions.
2. Conform to National and Local Life Safety Codes (whichever are more stringent), NFPA, NEC, this section, Joint Commission Life Safety Accreditation requirements, and OEM recommendations, instructions, and guidelines.
3. Provide supplies and materials listed by a nationally recognized testing laboratory where such standards are established for supplies, materials or equipment.
4. Refer to industry standards and minimum requirements of Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS and guidelines listed.
5. Active and passive equipment required by system design and approved technical submittal; must conform to each UL standard in effect for equipment, when technical submittal was reviewed and approved by Government or date when COR accepted system equipment to be replaced. Where a UL standard is in existence for equipment to be used in completion of this contract, equipment must bear approved NRTL label.

C. System Performance: Provide complete system to meet or exceed TIA Category 6 requirements.

D. Provide continuous inter- and/or intra-facility voice, data, and analog service.

1. Provide voice and data cable distribution system based on a physical "Star" topology.
2. Provide separate cable distribution system for emergency, safety and protection systems (i.e. emergency bypass phones; police emergency voice communications from parking lots and stairwells personal protection, duress alarms and annunciation systems; etc.)
3. Contact SMCS 005OP2H3 (202-462-5310) for specific technical assistance and approvals.

E. Specific Subsystem Requirements: Provide products necessary for a complete and functional voice, data, analog and videotele communications cabling system, including backbone cabling system, patch panels and cross-connections, horizontal cabling systems, jacks, faceplates, and patch cords.

F. Coordinate size and type of conduit, pathways and firestopping for maximum 40 percent cable fill with subcontractors.

G. Terminate all interconnecting twisted pair, fiber-optic or coaxial cables on patch panels or punch blocks. Terminate unused or spare conductors and fiber strands. Do not leave unused or spare twisted pair wire, fiber-optic or coaxial cable unterminated, unconnected, loose or unsecured.

H. Color code distribution wiring to conform to ANSI/TIA 606-B and construction documents, whichever is more stringent. Label all equipment, conduit, enclosures, jacks, and cables on record drawings, to facilitate installation and maintenance.



- I. In addition to requirements in Section 27 05 11, REQUIREMENTS FOR COMMUNICATION INSTALLATIONS, provide stainless steel faceplates with plastic covers over labels.

## **2.2 EQUIPMENT AND MATERIALS**

### **A. Cable Systems - Twisted Pair, Fiber optic, Coaxial and Analog:**

#### **1. General:**

- a. Provide cable (i.e. backbone, outside plant, and horizontal cabling) conforming to accepted industry standards with regards to size, color code, and insulation.
- b. Some areas can be considered "plenum". Comply with all codes pertaining to plenum environments. It is contractor's responsibility to review the VA's cable requirements with COR and OI&T Service prior to installation to confirm type of environment present at each location.
- c. Provide proper test equipment to confirm that cable pairs meet each OEM's standard transmission requirements, and ensure cable carries data transmissions at required speeds, frequencies, and fully loaded bandwidth.

#### **2. Telecommunications Rooms (TR):**

- a. In TR's served with UTP, fiber optic, coaxial and analog backbone cables, terminate UTP cable on RJ-45, 8-pin connectors of separate 48-port modular patch panels, 110A or equivalent type punch down blocks that are dedicated to voice and data applications.
- b. Provide fiber optic modular patch panels with "LC" couplers dedicated for voice, data and FMS applications.
- c. Provide connecting cables required to extend backbone cables (i.e. patch cords, twenty-five pair, etc.), to ensure complete and operational distribution systems.
- d. In TR's, which are only served by a UTP backbone cable, terminate cable on separate modular connecting devices, Type 110A punch down blocks (or equivalent), dedicated to data applications.

#### **3. Backbone Copper Cables:**

##### **a. Riser Cable:**

- 1) Provide communication riser cables listed in NEC Table 800, 154(a) for the purpose and suited for electrical connection to a communication network.
- 2) Provide STP or Unshielded Twisted Pair (UTP), minimum 24 American Wire Gauge (AWG) solid, thermoplastic insulated conductors for communication (analog RF coaxial cable is not to be provided in riser systems) riser cables with a thermoplastic outer jacket.
- 3) Label and test complete riser cabling system.

#### **4. Horizontal Cable: Installed from TCO jack to the TR patch panel.**

- a. Tested to ANSI/TIA-568-C.2 Category 6 requirements including NEXT, ELFEXT (Pair-to-Pair and Power Sum), Insertion Loss (attenuation), Return Loss, and Delay Skew.

- b. Minimum Transmission Parameters: 250 MHz.
  - c. Provide four pair 0.205 mm<sup>2</sup> (24 AWG) cable
  - d. Terminate all four pairs on same port at patch panel in TR.
  - e. Terminate all four pairs on same jack, at work area Telecommunication Outlets (TCO):
    - 1) Jacks: Minimum three eight-pin RJ-45 ANSI/TIA-568-C.2 Category 6 Type jacks at TCO.
      - a) Top Port: RJ-45 jack compatible with RJ-11 plug for voice.
      - b) Bottom Two Ports: Unkeyed RJ-45 jacks for data.
- 5. Fiber Optics Backbone Cable:
  - a. Provide 50/125 micron OM4 multi-mode cable, containing at minimum 18 strands of fiber, unless otherwise specified.
  - b. Provide loose tube cable, which separates individual fibers from the environment, or indoor/outdoor cables, for outdoor runs or any area that includes an outdoor run.
  - c. Provide tight buffered fiber cable or indoor/outdoor cables for indoor runs.
  - d. Terminate multimode fibers at both ends with LC type female connectors installed in an appropriate patch or breakout panel and secured with a cable management system. Provide minimum 610 mm (2 ft.) cable loop at each end.
  - e. Install fiber optic cables in TR's, Voice (Telephone) Switch Room, and Main Computer Room, in rack mounted fiber optic patch panels. Provide female LC couplers in appropriate panel for termination of each strand.
  - f. Test all fiber optic strands' cable transmission performance in accordance with TIA standards. Measure attenuation in accordance with fiber optic test procedures TIA-455-C ('-61', or -53). Provide written results to COR for review and approval.
- B. Cross-Connect Systems (CCS):
  - 1. Copper Cables: Provide copper CCS sized to connect cables at TR and allow for a minimum of 50 percent anticipated growth.
  - 2. Maximum DC Resistance per Cable Pair: 28.6 Ohms per 305 m (1,000 feet).
  - 3. Fiber Optic Cables:
    - a. Provide fiber CCS sized to connect cables at TR and allow for a minimum of 50 percent anticipated growth.
    - b. Install fiber optic cable slack in protective enclosures.
- C. Telecommunication Room (TR):
  - 1. Terminate backbone and horizontal, copper, fiber optic, coaxial and analog cables on appropriate cross-connection systems (CCS) containing patch panels, punch blocks, and breakout devices provided in enclosures and tested, regardless of installation method, mounting, termination, or cross-connecting used. Provide cable management system as a part of each CCS.

2. Coordinate location in TR with FMS equipment (i.e. fire alarm, nurse call, code blue, video, public address, radio entertainment, intercom, and radio paging equipment).
- D. Coaxial and Analog Cables: Bond equipment to ground per TIA standards, such that all grounding systems comply with all applicable National, Regional, and Local Building and Electrical codes.
  1. Provide current arrester for each copper or coaxial cable that enters from outside of a building regardless if cable is installed underground or aerial.
  2. Provide a gas surge protector/module and bond to earth ground.
- E. Main Cross-connection Subsystem (MCCS): MCCS is common point of distribution for inter- and intra-building copper and fiber optic backbone system cables, and connections to the voice (telephone) and data cable systems.
- F. Voice (or Telephone) Cable Cross-Connection Subsystem:
  1. Provide Insulation Displacement Connection (IDC) hardware.
  2. Provide the following for each Category 6, RJ-45 patch cord connector to RJ-45 patch cord connector.
    - a. Provide terminations to be accessible without need for disassembly of IDC wafer. Provide IDC wafers removable from their mounts to facilitate testing on either side of connector.
    - b. Provide removable designation strips or labels to allow for inspection of terminations.
    - c. Provide cable management system as a part of IDC.
  3. Provide IDC connectors capable of re-terminations, without damage, a minimum of 200 IDC insertions or withdrawals on either side of connector panel.
  4. Install using only non-impact terminating tool having both a tactile and an audible feedback to indicate proper termination.
  5. Provide system outputs from MCCS to voice backbone cable distribution system on the right side of same IDC (or 110A blocks) of MCCS.
  6. Do not split pairs within cables between different jacks or connections.
  7. Provide UTP cross connect wire to connect each pair of terminals plus an additional 50 percent spare.
- G. Data Cross-Connection Subsystems:
  1. Provide patch panels with modular RJ45 female to 110 connectors for cross-connection of copper data cable terminations and system ground with cable management system.
  2. Provide patch panels conforming to EIA/ECA 310-E dimensions and suitable for mounting in standard equipment racks, with 48 RJ45 jacks aligned in two horizontal rows per panel. Provide RJ45 jacks of modular design and capable of accepting and functioning with other modular (i.e. RJ11) plugs without damaging jack.
    - a. Provide system inputs from servers, data LAN, bridge, or interface distribution systems on top row of jacks of appropriate patch panel.

- b. Provide backbone cable connections on bottom row of jacks of same patch panel.
  - c. Provide patch cords for each system pair of connection jacks with modular RJ45 connectors provided on each end to match panel's modular RJ45 female jack's being provided.
- H. Fiber-Optic Cross-Connection Subsystems: Provide rack mounted patch or distribution panels installed inside a lockable cabinet or "breakout enclosure" that accommodate minimum 12 strands multimode fiber and 12 strand single mode fiber - these counts do not include 50 percent spare requirement. Provide cable management system for each panel.
  - 1. Provide panels for minimum 24 female LC connectors, able to accommodate splices and field mountable connectors and have capacity for additional connectors to be added up to OEM's maximum standard panel size for this type of use. Protect patch panel sides, including front and back, by a cabinet or enclosure.
  - 2. Provide panels that conform to EIA/ECA 310-E dimensions suitable for installation in standard racks, cabinets, and enclosures.
  - 3. Provide patch panels with highest OEM approved density of fiber LC termination's (maximum of 72 each), while maintaining a high level of manageability. Provide proper LC couplers installed for each pair of fiber optic cable LC connectors.
    - a. Provide system inputs from interface equipment or distribution systems on top row of connectors of appropriate patch panel.
    - b. Provide backbone cable connections on bottom row of connectors of same patch panel.
    - c. Provide patch cords for each pair of fiber optic strands with connector to match couplers.
  - 4. Provide field installable connectors that are pre-polished.
    - a. Terminate every fiber cable with appropriate connector, and test to ensure compliance to specifications and industry standards for fiber optic LC female connector terminated with a fiber optic cable.
    - b. Install a terminating cap for each unused LC connector.
  - 5. Provide copper cable system as a Star Topology.
- I. Horizontal Cabling (HC):
  - 1. Horizontal cable length to farthest system outlet to be maximum of 90 m (295 ft).
  - 2. Splitting of pairs within a cable between different jacks is not permitted.

## **2.3 DISTRIBUTION EQUIPMENT AND SYSTEMS**

- A. Telecommunication Outlet:
  - 1. TCO consists of minimum one voice (telephone) RJ45 jack and two data RJ45 jacks mounted in a separate steel outlet box 100 mm (4 inches) x 100 mm (4 inches) x 63 mm (2-1/2 inches) minimum with a labeled stainless steel faceplate. Where shown on drawings, provide a second steel outlet box minimum 100 mm (4 inches) x 100 mm (4 inches) x 63 mm (2-1/2

inches), with a labeled faceplate, adjacent to first box to ensure system connections and expandability requirements are met.

2. Provide RJ-45/11 compatible female type voice (telephone) multi-pin connections. Provide RJ-45 female type data multi-pin connections. Provide LC ceramic ferrule female type fiber optic connectors.
3. Provide wall outlet with a stainless steel face plate and sufficient ports to fit voice (telephone) multi-pin jack, data multi-pin jacks and plastic covers for labels when mounted on outlet box provided (minimum 100mm (4 inches) x 100mm (4 inches) for single and 100mm (4 inches) x 200mm (8 inches) for dual outlet box applications. Install stainless steel face plate, for prefabricated bedside patient unit installations.
4. Interface fiber optic LC jacks to appropriate patch panels in associated TR, but do not cross-connect fiber optic cables fiber optic equipment or install fiber optic equipment.

B. Backbone Distribution Cables:

1. Meet TIA transmission performance requirements of Voice Grade Category 3.
2. Provide cable listed for environments where it is installed.
3. Technical Characteristics:
  - a. Length: As required, in minimum 1 kilometer (3,000 ft.) reels.
  - b. Size:
    - 1) Minimum 0.326 mm<sup>2</sup> (22 AWG) outside plant installation.
    - 2) Minimum 0.205 mm<sup>2</sup> (24 AWG) interior installations.
  - c. Color Coding: American Telephone and Telegraph Company Standard; Bell System Practices Outside Plant Construction and Maintenance Section G50.607.3, Issue 2 February, 1959.
  - d. Minimum Bend Radius: 10X cable outside diameter.
  - e. Impedance: 120 Ohms + 15 percent.
  - f. DC Resistance: Maximum 8.00 ohms/100 m
  - g. Shield Coverage: As required by drawing notes single shield tape design.
  - h. Maximum attenuation for 100m at 20° C:

Frequency (MHz)	Category 3 (dB)			
.772	2.2			
1	2.6			
4	5.6			
8	8.5			
10	9.7			

Frequency (MHz)	Category 3 (dB)			
16	13.1			
20				
25				
31.25				
62.5				
100				
200				
250				
300				
400				
500				

4. Data Multi-Conductor:

- a. Unshielded cable with solid conductors.
- b. Able to handle the power and voltage used over the distance required.
- c. Meets TIA transmission performance requirements of Category 6.
- d. Technical Characteristics:
  - 1) 0.205 mm<sup>2</sup> (24 AWG) - 0.326 mm<sup>2</sup> (22 AWG) cable
  - 2) Bend Radius: 10 times cable outside diameter.
  - 3) Impedance: 100 Ohms + 15%, BAL.
  - 4) Bandwidth: 250 MHz.
  - 5) DC Resistance: Maximum 9.38 Ohms/100m (328 ft.) at 20 degrees C.
  - 6) Maximum Mutual Capacitance: 5.6 nF per 100 m (328 ft.).
  - 7) Shield Coverage:
    - a) Overall Outside (if OEM specified): 100 percent.
    - b) Individual Pairs (if OEM specified): 100 percent.
  - 8) Maximum attenuation for 100m (328 ft.) at 20° C:

Frequency (MHz)		Category 6 (dB)	
1		2.0	
4		3.8	
8		5.3	

Frequency (MHz)		Category 6 (dB)	
10		6.0	
16		7.6	
20		8.5	
25		9.5	
31.25		10.7	
62.5		15.4	
100		19.8	
200		29.0	
250		32.8	
300			
400			
500			

5. Fiber Optic:

a. Multimode Fiber:

- 1) Provide OM4 Type general purpose multimode fiber optic cable installed in conduit for system locations with load-bearing support braid surrounding inner tube for strength during cable installation.
- 2) Technical Characteristics:
  - a) Bend Radius: Minimum 152 mm (6 inches); outer jacket as required.
  - b) Fiber Diameter: 50 microns.
  - c) Cladding: 125 microns.
  - d) Attenuation:
    - 1) 850 nanometer: Maximum 4.0 dB per kilometer.
    - 2) 1,300 nanometer: Maximum 2.0 dB per kilometer.
  - e) Bandwidth:
    - 1) 850 nanometer: Minimum 160 MHz.
    - 2) 1,300 nanometer: Minimum 500 MHz.
  - f) Connectors: Stainless steel.

C. Outlet Connection Cables:

1. Voice (Telephone):

- a. Provide a connection cable for each TCO voice (telephone) jack in system with 10 percent spares able to connect voice (telephone) connection cable from voice (telephone) instrument to TCO voice (telephone) jack. Do not provide voice (telephone) instruments or equipment.
  - b. Technical Characteristics:
    - 1) Length: Minimum 1.8 m (6 feet).
    - 2) Cable: Voice Grade.
    - 3) Connector: RJ-11/45 compatible male on each end.
    - 4) Size: Minimum 24 AWG.
    - 5) Color Coding: Required, telephone industry standard.
2. Data:
- a. Provide a connection cable for each TCO data jack in system with 10 percent spares to connect a data instrument to TCO data jack. Do not provide data terminals/equipment.
  - b. Technical Characteristics:
    - 1) Length: Minimum 1.8 m (6 feet).
    - 2) Cable: Data grade Category 5E or on a case-by-case basis Category 6 for specialized powered systems accepted by SMCS 005OP2H3 (202) 461-5310, IT and FMS Services and COR.
    - 3) Connector: RJ-45 male on each end.
    - 4) Color Coding: Required, data industry standard.
    - 5) Size: Minimum 24 AWG.
3. Fiber Optic:
- a. Provide a connection cable for each TCO fiber optic connector in system with 10 percent spares. Provide data connection cable to connect a fiber optic instrument to TCO fiber optic jack. Do not provide fiber optic instruments/equipment.
  - b. Technical Characteristics:
    - 1) Length: Minimum 1.8 m (6 feet).
    - 2) Cable: Flexible single conductor with jacket.
    - 3) Connector: LC male on each end.
    - 4) Size: To fit OM4 multimode cable.
- D. System Connectors:
1. Modular (RJ-45/11 and RJ-45): Provide voice and high speed data transmission applications type modular plugs compatible with voice (telephone) instruments, computer terminals, and other type devices requiring linking through modular telecommunications outlet to the system compatible with UTP cables.
    - a. Technical Characteristics:
      - 1) Number of Pins:



- a) RJ-45: Eight.
  - b) RJ-11/45: Compatible with RJ-45.
- 2) Dielectric: Surge.
- 3) Voltage: Minimum 1,000V RMS, 60 Hz at one minute.
- 4) Current: 2.2A RMS at 30 minutes or 7.0A RMS at 5.0 seconds.
- 5) Leakage: Maximum 100  $\mu$ A.
- 6) Connections:
  - a) Initial contact resistance: Maximum 20 milli-Ohms.
  - b) Insulation displacement: Maximum 10 milli-Ohms.
  - c) Interface: Must interface with modular jacks from a variety of OEMs. RJ-11/45 plugs provide connection when used in RJ-45 jacks.
  - d) Durability: Minimum 200 insertions/withdrawals.
- E. Fiber Optic Terminators:
  - 1. Pre-polished crimp on type that has proper ferrule to terminate fiber optic cable.
  - 2. Technical Characteristics:
    - a. Frequency: Light wave.
    - b. Power Blocking: As required.
    - c. Return Loss: 25 dB.
    - d. Connectors: LC.
    - e. Construction: Ceramic.
- F. Conduit and Signal Ducts:
  - 1. Conduit:
    - a. Provide conduit or sleeves for cables penetrating walls, ceilings, floors, interstitial space, fire barriers, etc.
    - b. Minimum Conduit Size: 19 mm (3/4 inch).
    - c. Provide separate conduit and signal ducts for each cable type installation.
    - d. When metal (plastic covered, flexible cable protective armor, etc.) systems are authorized to be provided for use in system, follow installation guidelines and standard specified in Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS and NEC.
    - e. Maximum 40 percent conduit fill for cable installation.
  - 2. Signal Duct, Cable Duct, or Cable Tray: Use existing signal duct, cable duct, and cable tray, when identified and accepted by COR.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install for ease of operation, maintenance, and testing.

- B. Install system to comply with NFPA 70 National Electrical Code, NFPA 99 Health Care Facilities, NFPA 101 Life Safety Code, Joint Commission Manual for Health Care Facilities, and original equipment manufacturers' (OEM) installation instructions.
- C. Cable Systems Installation:
  - 1. Install system cables in cable duct, cable tray, cable runway, conduit or when specifically approved, flexible NEC Article 800 communications raceway. Confirm drawings show sufficient quantity and size of cable pathways. If flexible communications raceway is used, install in same manner as conduit.
  - 2. Coordinate outside plant and backbone cables to furnish number of cable pairs for system requirements and obtain approval of COR and IT Service prior to installation.
  - 3. Bond to ground metallic cable sheaths, etc. (i.e. risers, underground, horizontal, etc.).
  - 4. Install temporary cable to not present a pedestrian safety hazard and be responsible for all work associated with removal. Temporary cable installations are not required to meet Industry Standards; but, must be reviewed and accepted by COR, IT Service, FMS and SMCS 005OP2H3 (202-461-5310) prior to installation.
- D. Patient Bedside Prefabricated Units (PBPU) Installation:
  - 1. Under no circumstances, proceed with installing PBPU without written approval of PBPU OEM and specific instructions regarding attachment to or modifying of PBPU.
  - 2. Maintain UL integrity of each PBPU. If installation violates UL integrity, obtain on site UL re-certification of violated PBPU at the direction of COR.
- E. Labeling:
  - 1. Industry Standard: Provide labeling in accordance with ANSI/TIA-606-B.
  - 2. Print lettering of labels with laser printers; handwritten labels are not acceptable.
  - 3. Label both ends of all cables in accordance with industry standard. Provide permanent Labels in contrasting colors and identify according to system "Record Wiring Diagrams".
  - 4. Termination Hardware: Label workstation outlets and patch panel connections using color coded labels with identifiers in accordance with industry standard and record on "Record Wiring Diagrams".

### **3.2 FIELD QUALITY CONTROL**

- A. Interim Inspection:
  - 1. Verify that equipment provided adheres to installation requirements of this section. Interim inspection must be conducted by a factory-certified representative and witnessed by COR.
  - 2. Check each item of installed equipment to ensure appropriate NRTL label.
  - 3. Verify cabling terminations in telecommunications rooms and at workstations adhere to color code for T568B pin assignments and cabling connections comply with TIA standards.
  - 4. Visually confirm marking of cables, faceplates, patch panel connectors and patch cords.

5. Perform fiber optical field inspection tests via attenuation measurements on factory reels and provide results along with manufacturer certification for factory reel tests. Remove failed cable reels from project site upon attenuation test failure.
6. Notify COR of the estimated date the contractor expects to be ready for interim inspection, at least 20 working days before requested inspection date, so interim inspection does not affect systems' completion date.
7. Provide results of interim inspection to COR. If major or multiple deficiencies are discovered, COR can require a second interim inspection before permitting contractor to continue with system installation.
8. Do not proceed with installation until COR determines if an additional inspection is required. In either case, re-inspection of deficiencies noted during interim inspections must be part of the proof of performance test.

B. Acceptance Test:

1. After system has been pretested and the contractor has submitted pretest results and certification to COR, then schedule an acceptance test date and give COR 30 days' written notice prior to date acceptance test is expected to begin.
2. Test only in presence of a COR.
3. Test utilizing approved test equipment to certify proof of performance.
4. Verify that total system meets the requirements of this section.
5. Include expected duration of test time, with notification of the acceptance test.

C. Verification Tests:

1. Test UTP copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors, and between conductors and shield, if cable has an overall shield. Test cables after termination and prior to cross-connection.
2. Multi-mode Fiber Optic Cable: Perform end-to-end attenuation tests in accordance with TIA-568-B.3 and TIA-526-14A using Method A, Optical Power Meter and Light Source. Perform verification acceptance test.

D. Performance Testing:

1. Perform Category 5E (or on a case by case basis Category 6 for specialized powered systems accepted by SMCS 005OP2H3, (202) 461-5310, IT and FMS Services and COR) tests in accordance with TIA-568-B.1 and TIA-568-B.2. Include the following tests - wire map, length, insertion loss, return loss, NEXT, PSNEXT, ELFEXT, PSELFEXT, propagation delay and delay skew.
2. Fiber Optic Links: Perform end-to-end fiber optic cable link tests in accordance with TIA-568-B.3.

- E. Total System Acceptance Test: Perform verification tests for UTP copper cabling systems and multi-mode fiber optic cabling systems after complete telecommunication distribution system and workstation outlet are installed.

### **3.3 MAINTENANCE**

- A. Accomplish the following minimum requirements during one year warranty period:
1. Respond and correct on-site trouble calls, during standard work week:
    - a. A routine trouble call within one working day of its report. A routine trouble is considered a trouble which causes a system outlet, station, or patch cord to be inoperable.
    - b. Standard work week is considered 8:00 A.M. to 5:00 P.M., Monday through Friday exclusive of Federal holidays.
  2. Respond to an emergency trouble call within six hours of its report. An emergency trouble is considered a trouble which causes a subsystem or distribution point to be inoperable at any time.
  3. Respond on-site to a catastrophic trouble call within four hours of its report. A catastrophic trouble call is considered total system failure.
    - a. If a system failure cannot be corrected within four hours (exclusive of standard work time limits), provide alternate equipment, or cables within four hours after four hour trouble shooting time.
    - b. Routine or emergency trouble calls in critical emergency health care facilities (i.e., cardiac arrest, intensive care units, etc.) are also be deemed as a catastrophic trouble.
  4. Provide COR written report itemizing each deficiency found and the corrective action performed during each official reported trouble call. Provide COR with sample copies of reports for review and approval at beginning of total system acceptance test.

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**SECTION 28 05 00**  
**COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section, Common Work Results for Electronic Safety and Security (ESS), applies to all sections of Division 28.
- B. Furnish and install fully functional electronic safety and security cabling system(s), equipment and approved accessories in accordance with the specification section(s), drawing(s), and referenced publications. Capacities and ratings of cable and other items and arrangements for the specified items are shown on each system's required Bill of Materials (BOM) and verified on the approved system drawing(s). If there is a conflict between contract's specification(s) and drawings(s), the contract's specification requirements shall prevail.
- C. The Contractor shall provide a fully functional and operating ESS, programmed, configured, documented, and tested as required herein and the respective Safety and Security System Specification(s). The Contractor shall provide calculations and analysis to support design and engineering decisions as specified in submittals. The Contractor shall provide and pay all labor, materials, and equipment, sales and gross receipts and other taxes. The Contractor shall secure and pay for plan check fees, permits, other fees, and licenses necessary for the execution of work as applicable for the project. Give required notices; the Contractor will comply with codes, ordinances, regulations, and other legal requirements of public authorities, which bear on the performance of work.
- D. The Contractor shall provide an ESS, installed, programmed, configured, documented, and tested. The security system shall include but not limited to: physical access control, intrusion detection, duress alarms, elevator control interface, video assessment and surveillance, video recording and storage, delayed egress, personal protection system, intercommunication system, fire alarm interface, equipment cabinetry, dedicated photo badging system and associated live camera, report printer, photo badge printer, and uninterruptible power supplies (UPS) interface. Operator training shall not be required as part of the Security Contractors scope and shall be provided by the Owner. The Security Contractor shall still be required to provide necessary maintenance and troubleshooting manuals as well as submittals as identified herein. The work shall include the procurement and installation of electrical wire and cables, the installation and testing of all system components. Inspection, testing, demonstration, and acceptance of equipment, software, materials, installation, documentation, and workmanship, shall be as specified herein. The Contractor shall provide all associated installation support, including the provision of primary electrical input power circuits.
- E. Repair Service Replacement Parts On-site service during the warranty period shall be provided as specified under "Emergency Service". The Contractor shall guarantee all parts and labor for a

term of one (1) year, unless dictated otherwise in this specification from the acceptance date of the system as described in Part 5 of this Specification. The Contractor shall be responsible for all equipment, software, shipping, transportation charges, and expenses associated with the service of the system for one (1) year. The Contractor shall provide 24-hour telephone support for the software program at no additional charge to the owner. Software support shall include all software updates that occur during the warranty period.

F. Section Includes:

1. Description of Work for Electronic Security Systems,
2. Electronic security equipment coordination with relating Divisions,
3. Submittal Requirements for Electronic Security,
4. Miscellaneous Supporting equipment and materials for Electronic Security,
5. Electronic security installation requirements.

**1.2 RELATED WORK**

- A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.
- B. Section 07 84 00 - FIRESTOPPING. Requirements for firestopping application and use.
- C. Section 08 71 00 - DOOR HARDWARE. Requirements for door installation.
- D. Section 26 05 11 - REQUIREMENTS FOR ELECTRICAL INSTALLATIONS. Requirements for connection of high voltage.
- E. Section 26 05 19 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES. Requirements for power cables.
- F. Section 26 05 33 – RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS. Requirements for infrastructure.
- G. Section 28 31 00 - Fire Alarm.

**1.3 DEFINITIONS**

- A. AGC: Automatic Gain Control.
- B. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
- C. BICSI: Building Industry Consulting Service International.
- D. CCD: Charge-coupled device.
- E. Central Station: A PC with software designated as the main controlling PC of the security access system. Where this term is presented with initial capital letters, this definition applies.
- F. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel section.
- G. Controller: An intelligent peripheral control unit that uses a computer for controlling its operation. Where this term is presented with an initial capital letter, this definition applies.
- H. CPU: Central processing unit.
- I. Credential: Data assigned to an entity and used to identify that entity.

- J. DGP: Data Gathering Panel – component of the Physical Access Control System capable to communicate, store and process information received from readers, reader modules, input modules, output modules, and Security Management System.
- K. DTS: Digital Termination Service: A microwave-based, line-of-sight communications provided directly to the end user.
- L. EMI: Electromagnetic interference.
- M. EMT: Electric Metallic Tubing.
- N. ESS: Electronic Security System.
- O. File Server: A PC in a network that stores the programs and data files shared by users.
- P. GFI: Ground fault interrupter.
- Q. IDC: Insulation displacement connector.
- R. Identifier: A credential card, keypad personal identification number or code, biometric characteristic, or other unique identification entered as data into the entry-control database for the purpose of identifying an individual. Where this term is presented with an initial capital letter, this definition applies.
- S. I/O: Input/Output.
- T. Intrusion Zone: A space or area for which an intrusion must be detected and uniquely identified, the sensor or group of sensors assigned to perform the detection, and any interface equipment between sensors and communication link to central-station control unit.
- U. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- V. LAN: Local area network.
- W. LCD: Liquid-crystal display.
- X. LED: Light-emitting diode.
- Y. Location: A Location on the network having a PC-to-Controller communications link, with additional Controllers at the Location connected to the PC-to-Controller link with RS-485 communications loop. Where this term is presented with an initial capital letter, this definition applies.
- Z. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- AA. M-JPEG: Motion – Joint Photographic Experts Group.
- BB. MPEG: Moving picture experts group.
- CC. NEC: National Electric Code
- DD. NEMA: National Electrical Manufacturers Association
- EE. NFPA: National Fire Protection Association
- FF. NTSC: National Television System Committee.
- GG. NRTL: Nationally Recognized Testing Laboratory.

- HH. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).
- II. PACS: Physical Access Control System; A system comprised of cards, readers, door controllers, servers and software to control the physical ingress and egress of people within a given space
- JJ. PC: Personal computer. This acronym applies to the Central Station, workstations, and file servers.
- KK. PCI Bus: Peripheral component interconnect; a peripheral bus providing a high-speed data path between the CPU and peripheral devices (such as monitor, disk drive, or network).
- LL. PDF: (Portable Document Format.) The file format used by the Acrobat document exchange system software from Adobe.
- MM. RCDD: Registered Communications Distribution Designer.
- NN. RFI: Radio-frequency interference.
- OO. RIGID: Rigid conduit is galvanized steel tubing, with a tubing wall that is thick enough to allow it to be threaded.
- PP. RS-232: An TIA/EIA standard for asynchronous serial data communications between terminal devices. This standard defines a 25-pin connector and certain signal characteristics for interfacing computer equipment.
- QQ. RS-485: An TIA/EIA standard for multipoint communications.
- RR. Solid-Bottom or Non-ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal side rails, and a bottom without ventilation openings.
- SS. SMS: Security Management System – A SMS is software that incorporates multiple security subsystems (e.g., physical access control, intrusion detection, closed circuit television, intercom) into a single platform and graphical user interface.
- TT. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.
- UU. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.
- VV. UPS: Uninterruptible Power Supply
- XX. UTP: Unshielded Twisted Pair
- YY. Workstation: A PC with software that is configured for specific limited security system functions.

#### **1.4 QUALITY ASSURANCE**

- A. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.
- B. Product Qualification:
1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.



2. The Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.

C. Contractor Qualification:

1. The Contractor or security sub-contractor shall be a licensed security Contractor with a minimum of five (5) years experience installing and servicing systems of similar scope and complexity. The Contractor shall be an authorized regional representative of the Security Management System's (PACS) manufacturer. The Contractor shall provide four (4) current references from clients with systems of similar scope and complexity which became operational in the past three (3) years. At least three (3) of the references shall be utilizing the same system components, in a similar configuration as the proposed system. The references must include a current point of contact, company or agency name, address, telephone number, complete system description, date of completion, and approximate cost of the project. The owner reserves the option to visit the reference sites, with the site owner's permission and representative, to verify the quality of installation and the references' level of satisfaction with the system. The Contractor shall provide copies of system manufacturer certification for all technicians. The Contractor shall only utilize factory-trained technicians to install, program, and service the PACS. The Contractor shall only utilize factory-trained technicians to install, terminate and service controller/field panels and reader modules. The technicians shall have a minimum of five (5) continuous years of technical experience in electronic security systems. The Contractor shall have a local service facility. The facility shall be located within 60 miles of the project site. The local facility shall include sufficient spare parts inventory to support the service requirements associated with this contract. The facility shall also include appropriate diagnostic equipment to perform diagnostic procedures. The COR reserves the option of surveying the company's facility to verify the service inventory and presence of a local service organization.
2. The Contractor shall provide proof project superintendent with BICSI Certified Commercial Installer Level 1, Level 2, or Technician to provide oversight of the project.
3. Cable installer must have on staff a Registered Communication Distribution Designer (RCDD) certified by Building Industry Consulting Service International. The staff member shall provide consistent oversight of the project cabling throughout design, layout, installation, termination and testing.

- D. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four hours of receipt of notification that service is needed. Submit name and address of service organizations.

## **1.5 GENERAL ARRANGEMENT OF CONTRACT DOCUMENTS**

- A. The Contract Documents supplement to this specification indicates approximate locations of equipment. The installation and/or locations of the equipment and devices shall be governed by

the intent of the design; specification and Contract Documents, with due regard to actual site conditions, recommendations, ambient factors affecting the equipment and operations in the vicinity. The Contract Documents are diagrammatic and do not reveal all offsets, bends, elbows, components, materials, and other specific elements that may be required for proper installation. If any departure from the contract documents is deemed necessary, or in the event of conflicts, the Contractor shall submit details of such departures or conflicts in writing to the owner or owner's representative for his or her comment and/or approval before initiating work.

- B. Anything called for by one of the Contract Documents and not called for by the others shall be of like effect as if required or called by all, except if a provision clearly designed to negate or alter a provision contained in one or more of the other Contract Documents shall have the intended effect. In the event of conflicts among the Contract Documents, the Contract Documents shall take precedence in the following order: the Form of Agreement; the Supplemental General Conditions; the Special Conditions; the Specifications with attachments; and the drawings.

#### **1.6 SUBMITTALS**

- A. The Government's approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage or installation of equipment or material which has not had prior approval will not be permitted at the job site.
- B. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.
  - 1. Mark the submittals, "SUBMITTED UNDER SECTION\_\_\_\_\_".
  - 2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
  - 3. Submit each section separately.
- C. The submittals shall include the following:
  - 1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.
  - 2. Parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.
- D. Submittals shall be in full compliance of the Contract Documents. All submittals shall be provided in accordance with this section. Submittals lacking the breath or depth these requirements will be considered incomplete and rejected. Submissions are considered multidisciplinary and shall require coordination with applicable divisions to provide a complete and comprehensive submission package. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the Government to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for

approval shall be legible and clearly identify equipment being submitted. Additional general provisions are as follows:

1. The Contractor shall schedule submittals in order to maintain the project schedule. For coordination drawings refer to Specification Section 01 33 10 - DESIGN SUBMITTAL PROCEDURES, which outline basic submittal requirements and coordination. Section 01 33 10 shall be used in conjunction with this section.
2. The Contractor shall identify variations from requirements of Contract Documents and state product and system limitations, which may be detrimental to successful performance of the completed work or system.
3. Each package shall be submitted at one (1) time for each review and include components from applicable disciplines (e.g., electrical work, architectural finishes, door hardware, etc.) which are required to produce an accurate and detailed depiction of the project.
4. Manufacturer's information used for submittal shall have pages with items for approval tagged, items on pages shall be identified, and capacities and performance parameters for review shall be clearly marked through use of an arrow or highlighting. Provide space for COR and Contractor review stamps.
5. Technical Data Drawings shall be in the latest version of AutoCAD®, drawn accurately, and in accordance with VA CAD Standards CAD Standard Application Guide, and VA BIM Guide. FREEHAND SKETCHES OR COPIED VERSIONS OF THE CONSTRUCTION DOCUMENTS WILL NOT BE ACCEPTED. The Contractor shall not reproduce Contract Documents or copy standard information as the basis of the Technical Data Drawings. If departures from the technical data drawings are subsequently deemed necessary by the Contractor, details of such departures and the reasons thereof shall be submitted in writing to the COR for approval before the initiation of work.
6. Packaging: The Contractor shall organize the submissions according to the following packaging requirements.
  - a. Binders: For each manual, provide heavy duty, commercial quality, durable three (3) ring vinyl covered loose leaf binders, sized to receive 8.5 x 11 in paper, and appropriate capacity to accommodate the contents. Provide a clear plastic sleeve on the spine to hold labels describing the contents. Provide pockets in the covers to receive folded sheets.
    - 1) Where two (2) or more binders are necessary to accommodate data; correlate data in each binder into related groupings according to the Project Manual table of contents. Cross-referencing other binders where necessary to provide essential information for communication of proper operation and/or maintenance of the component or system.

- 2) Identify each binder on the front and spine with printed binder title, Project title or name, and subject matter covered. Indicate the volume number if applicable.
- b. Dividers: Provide heavy paper dividers with celluloid tabs for each Section. Mark each tab to indicate contents.
- c. Protective Plastic Jackets: Provide protective transparent plastic jackets designed to enclose diagnostic software for computerized electronic equipment.
- d. Text Material: Where written material is required as part of the manual use the manufacturer's standard printed material, or if not available, specially prepared data, neatly typewritten on 8.5 inches by 11 inches 20 pound white bond paper.
- e. Drawings: Where drawings and/or diagrams are required as part of the manual, provide reinforced punched binder tabs on the drawings and bind them with the text.
  - 1) Where oversized drawings are necessary, fold the drawings to the same size as the text pages and use as a foldout.
  - 2) If drawings are too large to be used practically as a foldout, place the drawing, neatly folded, in the front or rear pocket of the binder. Insert a type written page indicating the drawing title, description of contents and drawing location at the appropriate location of the manual.
  - 3) Drawings shall be sized to ensure details and text is of legible size. Text shall be no less than 1/16" tall.
- f. Manual Content: Submit in accordance with Section 01 00 00, GENERAL REQUIREMENTS.
  - 1) Maintenance and Operation Manuals: Submit as required for systems and equipment specified in the technical sections. Furnish four copies, bound in hardback binders, (manufacturer's standard binders) or an approved equivalent. Furnish one complete manual as specified in the technical section but in no case later than prior to performance of systems or equipment test, and furnish the remaining manuals prior to contract completion.
  - 2) Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, equipment, building, name of Contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment.
  - 3) The manuals shall include:
    - a) Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
    - b) A control sequence describing start-up, operation, and shutdown.
    - c) Description of the function of each principal item of equipment.

- d) Installation and maintenance instructions.
  - e) Safety precautions.
  - f) Diagrams and illustrations.
  - g) Testing methods.
  - h) Performance data.
- g. Binder Organization: Organize each manual into separate sections for each piece of related equipment. At a minimum, each manual shall contain a title page, table of contents, copies of Product Data supplemented by drawings and written text, and copies of each warranty, bond, certifications, and service Contract issued. Refer to Group I through V Technical Data Package Submittal requirements for required section content.
- h. Title Page: Provide a title page as the first sheet of each manual to include the following information; project name and address, subject matter covered by the manual, name and address of the Project, date of the submittal, name, address, and telephone number of the Contractor, and cross references to related systems in other operating and/or maintenance manuals.
- i. Table of Contents: After the title page, include a type written table of contents for each volume, arranged systematically according to the Project Manual format. Provide a list of each product included, identified by product name or other appropriate identifying symbols and indexed to the content of the volume. Where more than one (1) volume is required to hold data for a particular system, provide a comprehensive table of contents for all volumes in each volume of the set.
- j. General Information Section: Provide a general information section immediately following the table of contents, listing each product included in the manual, identified by product name. Under each product, list the name, address, and telephone number of the installer and maintenance Contractor. In addition, list a local source for replacement parts and equipment.
- k. Drawings: Provide specially prepared drawings where necessary to supplement the manufacturers printed data to illustrate the relationship between components of equipment or systems, or provide control or flow diagrams. Coordinate these drawings with information contained in Project Record Drawings to assure correct illustration of the completed installation.
- l. Manufacturer's Data: Where manufacturer's standard printed data is included in the manuals, include only those sheets that are pertinent to the part or product installed. Mark each sheet to identify each part or product included in the installation. Where more than one (1) item in tabular format is included, identify each item, using appropriate references from the Contract Documents. Identify data that is applicable to the installation and delete references to information which is not applicable.

- m. Where manufacturer's standard printed data is not available and the information is necessary for proper operation and maintenance of equipment or systems, or it is necessary to provide additional information to supplement the data included in the manual, prepare written text to provide the necessary information. Organize the text in a consistent format under a separate heading for different procedures. Where necessary, provide a logical sequence of instruction for each operating or maintenance procedure. Where similar or more than one product is listed on the submittal the Contractor shall differentiate by highlighting the specific product to be utilized.
- 7. Contractor Review: Review submittals prior to transmittal. Determine and verify field measurements and field construction criteria. Verify manufacturer's catalog numbers and conformance of submittal with requirements of contract documents. Return non-conforming or incomplete submittals with requirements of the work and contract documents. Apply Contractor's stamp with signature certifying the review and verification of products occurred, and the field dimensions, adjacent construction, and coordination of information is in accordance with the requirements of the contract documents.
- 8. Resubmission: Revise and resubmit submittals as required within 15 calendar days of return of submittal. Make resubmissions under procedures specified for initial submittals. Identify all changes made since previous submittal.
- 9. Product Data: Within 15 calendar days after execution of the contract, the Contractor shall submit for approval a complete list of all of major products proposed for use. The data shall include name of manufacturer, trade name, model number, the associated contract document section number, paragraph number, and the referenced standards for each listed product.
- E. Group 1 Technical Data Package: Group I Technical Data Package shall be one submittal consisting of the following content and organization. Refer to VA Special Conditions Document for drawing format and content requirements. The data package shall include the following:
  - 1. Section I - Drawings:
    - a. General – Drawings shall conform to VA CAD Standards Guide. All text associated with security details shall be 1/8" tall and meet VA text standard for AutoCAD™ drawings.
    - b. Cover Sheet – Cover sheet shall consist of Project Title and Address, Project Number, Area and Vicinity Maps.
    - c. General Information Sheets – General Information Sheets shall consist of General Notes, Abbreviations, Symbols, Wire and Cable Schedule, Project Phasing, and Sheet Index.
    - d. Floor Plans – Floor plans shall be produced from the Architectural backgrounds issued in the Construction Documents. The contractor shall receive floor plans from the prime A/E to develop these drawing sets. Security devices shall be placed on drawings in scale. All text associated with security details shall be 1/8" tall and meet VA text standard for AutoCAD™ drawings. Floor plans shall identify the following:

- 1) Security devices by symbol,
  - 2) The associated device point number (derived from the loading sheets),
  - 3) Wire & cable types and counts
  - 4) Conduit sizing and routing
  - 5) Conduit riser systems
  - 6) Device and area detail call outs
- e. Architectural details – Architectural details shall be produced for each device mounting type (door details for EECS and IDS, Intrusion Detection system (motion sensor, vibration, microwave Motion Sensor and Camera mounting).
  - f. Riser Diagrams – Contractor shall provide a riser diagram indicating riser architecture and distribution of the SMS throughout the facility (or area in scope).
  - g. Block Diagrams – Contractor shall provide a block diagram for the entire system architecture and interconnections with SMS subsystems. Block diagram shall identify SMS subsystem (e.g., electronic entry control, intrusion detection, closed circuit television, intercom, and other associated subsystems) integration; and data transmission and media conversion methodologies.
  - h. Interconnection Diagrams – Contractor shall provide interconnection diagram for each sensor, and device component. Interconnection diagram shall identify termination locations, standard wire detail to include termination schedule. Diagram shall also identify interfaces to other systems such as elevator control, fire alarm systems, and security management systems.
2. Section IV - Manufacturers' Data: The data package shall include manufacturers' data for all materials and equipment, including sensors, local processors and console equipment provided under this specification.
  3. Section VI – Certifications & References: All specified manufacturer's certifications shall be included with the data package. Contractor shall provide Project references as outlined in Paragraph 1.4 "Quality Assurance".
- F. Group III Technical Data Package
1. Development of Test Procedures: The Contractor will prepare performance test procedures for the system testing. The test procedures shall follow the format of the VA Testing procedures and be customized to the contract requirements. The Contractor will deliver the test procedures to the COR for approval at least 60 calendar days prior to the requested test date.
- G. Group IV Technical Data Package
1. Performance Verification Test
    - a. Based on the successful completion of the pre-delivery test, the Contractor shall finalize the test procedures and report forms for the performance verification test (PVT) and the

endurance test. The PVT shall follow the format, layout and content of the pre-delivery test. The Contractor shall deliver the PVT and endurance test procedures to the COR for approval. The Contractor may schedule the PVT after receiving written approval of the test procedures. The Contractor shall deliver the final PVT and endurance test reports within 14 calendar days from completion of the tests. Refer to Part 3 of this section for System Testing and Acceptance requirements.

2. Training Documentation

- a. New Facilities and Major Renovations: Familiarization training shall be provided for new equipment or systems. Training can include site familiarization training for VA technicians and administrative personnel. Training shall include general information on new system layout including closet locations, turnover of the completed system including all documentation, including manuals, software, key systems, and full system administration rights. Lesson plans and training manuals training shall be oriented to type of training to be provided.
- b. New Unit Control Room:
  - 1) Provide the security personnel with training in the use, operation, and maintenance of the entire control room system (Unit Control and Equipment Rooms). The training documentation must include the operation and maintenance. The first of the training sessions shall take place prior to system turnover and the second immediately after turnover. Coordinate the training sessions with the Owner. Completed classroom sessions will be witnessed and documented by the Architect/Engineer, and approved by the COR. Instruction is not to begin until the system is operational as designed.
  - 2) The training documents will cover the operation and the maintenance manuals and the control console operators' manuals and service manuals in detail, stressing all important operational and service diagnostic information necessary for the maintenance and operations personnel to efficiently use and maintain all systems.
  - 3) Provide an illustrated control console operator's manual and service manual. The operator's manual shall be written in laymen's language and printed so as to become a permanent reference document for the operators, describing all control panel switch operations, graphic symbol definitions and all indicating functions and a complete explanation of all software.
  - 4) The service manual shall be written in laymen's language and printed so as to become a permanent reference document for maintenance personnel, describing how to run internal self diagnostic software programs, troubleshoot head end hardware and field devices with a complete scenario simulation of all possible system malfunctions and the appropriate corrective measures.



- 5) Provide a professional color DVD instructional recording of all the operational procedures described in the operator's manual. All charts used in the training session shall be clearly presented on the video. Any DVD found to be inferior in recording or material content shall be reproduced at no cost until an acceptable DVD is submitted. Provide four copies of the training DVD, one to the architect/engineer and three to the owner.
3. System Configuration and Data Entry:
    - a. The contractor is responsible for providing all system configuration and data entry for the SMS and subsystems (e.g., video matrix switch, intercom, digital video recorders, network video recorders). All data entry shall be performed per VA standards & guidelines. The Contractor is responsible for participating in all meetings with the client to compile the information needed for data entry. These meetings shall be established at the beginning of the project and incorporated in to the project schedule as a milestone task. The contractor shall be responsible for all data collection, data entry, and system configuration. The contractor shall collect, enter, & program and/or configure the following components:
      - 1) Physical Access control system components,
      - 2) All intrusion detection system components,
      - 3) Video surveillance, control and recording systems,
      - 4) Intercom systems components,
      - 5) All other security subsystems shown in the contract documents.
    - b. The Contractor is responsible for compiling the card access database for the VA employees, including programming reader configurations, access shifts, schedules, exceptions, card classes and card enrollment databases.
    - c. Refer to Part 3 for system programming requirements and planning guidelines.
  - H. Group V Technical Data Package: Final copies of the manuals shall be delivered to the COR as part of the acceptance test. The draft copy used during site testing shall be updated with any changes required prior to final delivery of the manuals. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of each sub-contractor installing equipment or systems, as well as the nearest service representatives for each item of equipment for each system. The manuals shall include a table of contents and tab sheets. Tab sheets shall be placed at the beginning of each chapter or section and at the beginning of each appendix. The final copies delivered after completion of the endurance test shall include all modifications made during installation, checkout, and acceptance. Six (6) hard-copies and one (1) soft copy on CD of each item listed below shall be delivered as a part of final systems acceptance.

1. Functional Design Manual: The functional design manual shall identify the operational requirements for the entire system and explain the theory of operation, design philosophy, and specific functions. A description of hardware and software functions, interfaces, and requirements shall be included for all system operating modes. Manufacturer developed literature may be used; however, shall be produced to match the project requirements.
2. Equipment Manual: A manual describing all equipment furnished including:
  - a. General description and specifications; installation and checkout procedures; equipment electrical schematics and layout drawings; system schematics and layout drawings; alignment and calibration procedures; manufacturer's repair list indicating sources of supply; and interface definition.
3. Software Manual: The software manual shall describe the functions of all software and include all other information necessary to enable proper loading, testing, and operation. The manual shall include:
  - a. Definition of terms and functions; use of system and applications software; procedures for system initialization, start-up, and shutdown; alarm reports; reports generation, database format and data entry requirements; directory of all disk files; and description of all communications protocols including data formats, command characters, and a sample of each type of data transfer.
4. Operator's Manual: The operator's manual shall fully explain all procedures and instructions for the operation of the system, including:
  - a. Computers and peripherals; system start-up and shutdown procedures; use of system, command, and applications software; recovery and restart procedures; graphic alarm presentation; use of report generator and generation of reports; data entry; operator commands' alarm messages, and printing formats; and system access requirements.
5. Maintenance Manual: The maintenance manual shall include descriptions of maintenance for all equipment including inspection, recommend schedules, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.
6. Spare Parts & Components Data: At the conclusion of the Contractor's work, the Contractor shall submit to the COR a complete list of the manufacturer's recommended spare parts and components required to satisfactorily maintain and service the systems, as well as unit pricing for those parts and components.
7. Operation, Maintenance & Service Manuals: The Contractor shall provide two (2) complete sets of operating and maintenance manuals in the form of an instructional manual for use by the VA Security Guard Force personnel. The manuals shall be organized into suitable sets of manageable size. Where possible, assemble instructions for similar equipment into a single binder. If multiple volumes are required, each volume shall be fully indexed and coordinated.

8. Equipment and Systems Maintenance Manual: The Contractor shall provide the following descriptive information for each piece of equipment, operating system, and electronic system:
  - a. Equipment and/or system function.
  - b. Operating characteristics.
  - c. Limiting conditions.
  - d. Performance curves.
  - e. Engineering data and test.
  - f. Complete nomenclature and number of replacement parts.
  - g. Provide operating and maintenance instructions including assembly drawings and diagrams required for maintenance and a list of items recommended to stock as spare parts.
  - h. Provide information detailing essential maintenance procedures including the following: routine operations, trouble shooting guide, disassembly, repair and re-assembly, alignment, adjusting, and checking.
  - i. Provide information on equipment and system operating procedures, including the following; start-up procedures, routine and normal operating instructions, regulation and control procedures, instructions on stopping, shut-down and emergency instructions, required sequences for electric and electronic systems, and special operating instructions.
  - j. Manufacturer equipment and systems maintenance manuals are permissible.
9. Project Redlines: During construction, the Contractor shall maintain an up-to-date set of construction redlines detailing current location and configuration of the project components. The redline documents shall be marked with the words 'Master Redlines' on the cover sheet and be maintained by the Contractor in the project office. The Contractor will provide access to redline documents anytime during the project for review and inspection by the COR or authorized Office of Protection Services representative. Master redlines shall be neatly maintained throughout the project and secured under lock and key in the contractor's onsite project office. Any project component or assembly that is not installed in strict accordance with the drawings shall be so noted on the drawings. Prior to producing Record Construction Documents, the contractor will submit the Master Redline document to the COR for review and approval of all changes or modifications to the documents. Each sheet shall have COR initials indicating authorization to produce "As Built" documents. Field drawings shall be used for data gathering & field changes. These changes shall be made to the master redline documents daily. Field drawings shall not be considered "master redlines".
10. Record Specifications: The Contractor shall maintain one (1) copy of the Project Specifications, including addenda and modifications issued, for Project Record Documents. The Contractor shall mark the Specifications to indicate the actual installation where the

- installation varies substantially from that indicated in the Contract Specifications and modifications issued. (Note related Project Record Drawing information where applicable). The Contractor shall pay particular attention to substitutions, selection of product options, and information on concealed installations that would be difficult to identify or measure and record later. Upon completion of the mark ups, the Contractor shall submit record Specifications to the COR. As with master relines, Contractor shall maintain record specifications for COR review and inspection at anytime.
11. Record Product Data: The Contractor shall maintain one (1) copy of each Product Data submittal for Project Record Document purposes. The Data shall be marked to indicate the actual product installed where the installation varies substantially from that indicated in the Product Data submitted. Significant changes in the product delivered to the site and changes in manufacturer's instructions and recommendations for installation shall be included. Particular attention will be given to information on concealed products and installations that cannot be readily identified or recorded later. Note related Change Orders and mark up of Record Construction Documents, where applicable. Upon completion of mark up, submit a complete set of Record Product Data to the COR.
  12. Miscellaneous Records: The Contractor shall maintain one (1) copy of miscellaneous records for Project Record Document purposes. Refer to other Specifications for miscellaneous record-keeping requirements and submittals concerning various construction activities. Before substantial completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for use and reference. Categories of requirements resulting in miscellaneous records include a minimum of the following:
    - a. Certificates received instead of labels on bulk products.
    - b. Testing and qualification of tradesmen. ("Contractor's Qualifications")
    - c. Documented qualification of installation firms.
    - d. Load and performance testing.
    - e. Inspections and certifications.
    - f. Final inspection and correction procedures.
    - g. Project schedule
  13. Record Construction Documents (Record As-Built)
    - a. Upon project completion, the contractor shall submit the project master redlines to the COR prior to development of Record construction documents. The COR shall be given a minimum of a thirty (30) day review period to determine the adequacy of the master redlines. If the master redlines are found suitable by the COR, the COR will initial and date each sheet and turn redlines over to the contractor for as built development.
    - b. The Contractor shall provide the COR a complete set of "as-built" drawings and original master redlined marked "as-built" blue-line in the latest version of AutoCAD drawings

unlocked on CD or DVD. The as-built drawing shall include security device number, security closet connection location, data gathering panel number, and input or output number as applicable. All corrective notations made by the Contractor shall be legible when submitted to the COR. If, in the opinion of the COR, any redlined notation is not legible, it shall be returned to the Contractor for re-submission at no extra cost to the Owner. The Contractor shall organize the Record Drawing sheets into manageable sets bound with durable paper cover sheets with suitable titles, dates, and other identifications printed on the cover. The submitted as built shall be in editable formats and the ownership of the drawings shall be fully relinquished to the owner.

- c. Where feasible, the individual or entity that obtained record data, whether the individual or entity is the installer, sub-contractor, or similar entity, is required to prepare the mark up on Record Drawings. Accurately record the information in a comprehensive drawing technique. Record the data when possible after it has been obtained. For concealed installations, record and check the mark up before concealment. At the time of substantial completion, submit the Record Construction Documents to the COR. The Contractor shall organize into bound and labeled sets for the COR's continued usage. Provide device, conduit, and cable lengths on the conduit drawings. Exact in-field conduit placement/routings shall be shown. All conduits shall be illustrated in their entire length from termination in security closets; no arrowed conduit runs shall be shown. Pull box and junction box sizes are to be shown if larger than 100mm (4 inch).
- I. FIPS 201 Compliance Certificates
  - 1. Provide Certificates for all software components and device types utilizing credential verification. Provide certificates for:
    - a. Fingerprint Capture Station
    - b. Card Readers
    - c. Facial Image Capturing Camera
    - d. PIV Middleware
    - e. Template Matcher
    - f. Electromagnetically Opaque Sleeve
    - g. Certificate Management
      - 1) CAK Authentication System
      - 2) PIV Authentication System
      - 3) Certificate Validator
      - 4) Cryptographic Module
- J. Approvals will be based on complete submission of manuals together with shop drawings.
- K. After approval and prior to installation, furnish the COR with one sample of each of the following:

1. A 300 mm (12 inch) length of each type and size of wire and cable along with the tag from the coils of reels from which the samples were taken.
2. Each type of conduit and pathway coupling, bushing and termination fitting.
3. Conduit hangers, clamps and supports.
4. Duct sealing compound.

#### 1.7 APPLICABLE PUBLICATIONS

- A. The publications listed below (including amendments, addenda, revisions, supplement, and errata) form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standards Institute (ANSI)/ International Code Council (ICC):  
A117.1 ..... Standard on Accessible and Usable Buildings and Facilities
- C. American National Standards Institute (ANSI)/ Security Industry Association (SIA):  
AC-03 ..... Access Control: Access Control Guideline Dye Sublimation  
Printing Practices for PVC Access Control Cards  
CP-01-00 ..... Control Panel Standard-Features for False Alarm Reduction  
PIR-01-00 ..... Passive Infrared Motion Detector Standard - Features for  
Enhancing False Alarm Immunity  
TVAC-01 ..... CCTV to Access Control Standard - Message Set for System  
Integration
- D. American National Standards Institute (ANSI)/Electronic Industries Alliance (EIA):  
330-09 ..... Electrical Performance Standards for CCTV Cameras  
375A-76 ..... Electrical Performance Standards for CCTV Monitors
- E. American National Standards Institute (ANSI):  
ANSI S3.2-99 ..... Method for measuring the Intelligibility of Speech over  
Communications Systems
- F. American Society for Testing and Materials (ASTM)  
B1-07 ..... Standard Specification for Hard-Drawn Copper Wire  
B3-07 ..... Standard Specification for Soft or Annealed Copper Wire  
B8-04 ..... Standard Specification for Concentric-Lay-Stranded Copper  
Conductors, Hard, Medium-Hard, or Soft  
C1238-97 (R03) ..... Standard Guide for Installation of Walk-Through Metal Detectors  
D2301-04 ..... Standard Specification for Vinyl Chloride Plastic Pressure  
Sensitive Electrical Insulating Tape
- G. Architectural Barriers Act (ABA), 1968
- H. Department of Justice: American Disability Act (ADA)  
28 CFR Part 36-2010 ADA Standards for Accessible Design
- I. Department of Veterans Affairs:

VHA National CAD Standard Application Guide, 2006

VA BIM Guide, V1.0 10

J. Federal Communications Commission (FCC):

(47 CFR 15) Part 15 Limitations on the Use of Wireless Equipment/Systems

K. Federal Information Processing Standards (FIPS):

FIPS-201-1 ..... Personal Identity Verification (PIV) of Federal Employees and  
Contractors

L. Federal Specifications (Fed. Spec.):

A-A-59544-08 ..... Cable and Wire, Electrical (Power, Fixed Installation)

M. Government Accountability Office (GAO):

GAO-03-8-02 ..... Security Responsibilities for Federally Owned and Leased  
Facilities

N. Homeland Security Presidential Directive (HSPD):

HSPD-12 ..... Policy for a Common Identification Standard for Federal  
Employees and Contractors

O. Institute of Electrical and Electronics Engineers (IEEE):

81-1983 ..... IEEE Guide for Measuring Earth Resistivity, Ground Impedance,  
and Earth Surface Potentials of a Ground System

802.3af-08 ..... Power over Ethernet Standard

802.3at-09 ..... Power over Ethernet (PoE) Plus Standard

C2-07 ..... National Electrical Safety Code

C62.41-02 ..... IEEE Recommended Practice on Surge Voltages in Low-Voltage  
AC Power Circuits

C95.1-05 ..... Standards for Safety Levels with Respect to Human Exposure in  
Radio Frequency Electromagnetic Fields

P. International Organization for Standardization (ISO):

7810 ..... Identification cards – Physical characteristics

7811 ..... Physical Characteristics for Magnetic Stripe Cards

7816-1 ..... Identification cards - Integrated circuit(s) cards with contacts -  
Part 1: Physical characteristics

7816-2 ..... Identification cards - Integrated circuit cards - Part 2: Cards with  
contacts -Dimensions and location of the contacts

7816-3 ..... Identification cards - Integrated circuit cards - Part 3: Cards with  
contacts - Electrical interface and transmission protocols

7816-4 ..... Identification cards - Integrated circuit cards - Part 11: Personal  
verification through biometric methods

- 7816-10 ..... Identification cards - Integrated circuit cards - Part 4:  
Organization, security and commands for interchange
- 14443 ..... Identification cards - Contactless integrated circuit cards;  
Contactless Proximity Cards Operating at 13.56 MHz in up to 5  
inches distance
- 15693 ..... Identification cards -- Contactless integrated circuit cards -  
Vicinity cards; Contactless Vicinity Cards Operating at 13.56  
MHz in up to 50 inches distance
- 19794 ..... Information technology - Biometric data interchange formats
- Q. National Electrical Contractors Association
  - 303-2005 ..... Installing Closed Circuit Television (CCTV) Systems
- R. National Electrical Manufacturers Association (NEMA):
  - 250-08 ..... Enclosures for Electrical Equipment (1000 Volts Maximum)
  - TC-3-04 ..... PVC Fittings for Use with Rigid PVC Conduit and Tubing
  - FB1-07 ..... Fittings, Cast Metal Boxes and Conduit Bodies for Conduit,  
Electrical Metallic Tubing and Cable
- S. National Fire Protection Association (NFPA):
  - 70-11 ..... National Electrical Code (NEC)
  - 731-08 ..... Standards for the Installation of Electric Premises Security  
Systems
  - 99-2005 ..... Health Care Facilities
- T. National Institute of Justice (NIJ)
  - 0601.02-03 ..... Standards for Walk-Through Metal Detectors for use in  
Weapons Detection
  - 0602.02-03 ..... Hand-Held Metal Detectors for Use in Concealed Weapon and  
Contraband Detection
- U. National Institute of Standards and Technology (NIST):
  - IR 6887 V2.1 ..... Government Smart Card Interoperability Specification (GSC-IS)
  - Special Pub 800-37 ..... Guide for Applying the Risk Management Framework to Federal  
Information Systems
  - Special Pub 800-63 ..... Electronic Authentication Guideline
  - Special Pub 800-73-3 ..... Interfaces for Personal Identity Verification (4 Parts)
    - ..... Pt. 1- End Point PIV Card Application Namespace, Data Model &  
Representation
    - ..... Pt. 2- PIV Card Application Card Command Interface
    - ..... Pt. 3- PIV Client Application Programming Interface
    - ..... Pt. 4- The PIV Transitional Interfaces & Data Model Specification



- Special Pub 800-76-1 ..... Biometric Data Specification for Personal Identity Verification
- Special Pub 800-78-2 ..... Cryptographic Algorithms and Key Sizes for Personal Identity Verification
- Special Pub 800-79-1 ..... Guidelines for the Accreditation of Personal Identity Verification Card Issuers
- Special Pub 800-85B-1 ..... DRAFTPIV Data Model Test Guidelines
- Special Pub 800-85A-2 ..... PIV Card Application and Middleware Interface Test Guidelines (SP 800-73-3 compliance)
- Special Pub 800-96..... PIV Card Reader Interoperability Guidelines
- Special Pub 800-104A ..... Scheme for PIV Visual Card Topography
- V. Occupational and Safety Health Administration (OSHA):
  - 29 CFR 1910.97 ..... Nonionizing radiation
- W. Section 508 of the Rehabilitation Act of 1973
- X. Security Industry Association (SIA):
  - AG-01 ..... Security CAD Symbols Standards
- Y. Underwriters Laboratories, Inc. (UL):
  - 1-05 ..... Flexible Metal Conduit
  - 5-04 ..... Surface Metal Raceway and Fittings
  - 6-07 ..... Rigid Metal Conduit
  - 44-05 ..... Thermoset-Insulated Wires and Cables
  - 50-07 ..... Enclosures for Electrical Equipment
  - 83-08 ..... Thermoplastic-Insulated Wires and Cables
  - 294-99 ..... The Standard of Safety for Access Control System Units
  - 305-08 ..... Standard for Panic Hardware
  - 360-09 ..... Liquid-Tight Flexible Steel Conduit
  - 444-08 ..... Safety Communications Cables
  - 464-09 ..... Audible Signal Appliances
  - 467-07 ..... Electrical Grounding and Bonding Equipment
  - 486A-03..... Wire Connectors and Soldering Lugs for Use with Copper Conductors
  - 486C-04 ..... Splicing Wire Connectors
  - 486D-05 ..... Insulated Wire Connector Systems for Underground Use or in Damp or Wet Locations
  - 486E-00..... Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
  - 493-07 ..... Thermoplastic-Insulated Underground Feeder and Branch Circuit Cable

514A-04.....	Metallic Outlet Boxes
514B-04.....	Fittings for Cable and Conduit
51-05 .....	Schedule 40 and 80 Rigid PVC Conduit
609-96 .....	Local Burglar Alarm Units and Systems
634-07 .....	Standards for Connectors with Burglar-Alarm Systems
636-01 .....	Standard for Holdup Alarm Units and Systems
639-97 .....	Standard for Intrusion-Detection Units
651-05 .....	Schedule 40 and 80 Rigid PVC Conduit
651A-07 .....	Type EB and A Rigid PVC Conduit and HDPE Conduit
752-05 .....	Standard for Bullet-Resisting Equipment
797-07 .....	Electrical Metallic Tubing
827-08 .....	Central Station Alarm Services
1037-09 .....	Standard for Anti-theft Alarms and Devices
1635-10 .....	Digital Alarm Communicator System Units
1076-95 .....	Standards for Proprietary Burglar Alarm Units and Systems
1242-06 .....	Intermediate Metal Conduit
1479-03 .....	Fire Tests of Through-Penetration Fire Stops
1981-03 .....	Central Station Automation System
2058-05 .....	High Security Electronic Locks
60950 .....	Safety of Information Technology Equipment
60950-1 .....	Information Technology Equipment - Safety - Part 1: General Requirements

Z. Uniform Federal Accessibility Standards (UFAS) 1984

AA. United States Department of Commerce:

Special Pub 500-101 ..... Care and Handling of Computer Magnetic Storage Media

## **1.8 COORDINATION**

A. Coordinate arrangement, mounting, and support of electronic safety and security equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

- C. Coordinate location of access panels and doors for electronic safety and security items that are behind finished surfaces or otherwise concealed.

### **1.9 MINIMUM REQUIREMENTS**

- A. References to industry and trade association standards and codes are minimum installation requirement standards.
- B. Drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the above standards.

### **1.10 DELIVERY, STORAGE, & HANDLING**

- A. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, moisture, cold and rain:
  - 1. During installation, enclosures, equipment, controls, controllers, circuit protective devices, and other like items, shall be protected against entry of foreign matter; and be vacuum cleaned both inside and outside before testing and operating and repainting if required.
  - 2. Damaged equipment shall be, as determined by the COR, placed in first class operating condition or be returned to the source of supply for repair or replacement.
  - 3. Painted surfaces shall be protected with factory installed removable heavy craft paper, sheet vinyl or equal.
  - 4. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.
- B. Central Station, Workstations, and Controllers:
  - 1. Store in temperature and humidity controlled environment in original manufacturer's sealed containers. Maintain ambient temperature between 10 to 30 deg C (50 to 85 deg F), and not more than 80 percent relative humidity, non-condensing.
  - 2. Open each container; verify contents against packing list, and file copy of packing list, complete with container identification for inclusion in operation and maintenance data.
  - 3. Mark packing list with designations which have been assigned to materials and equipment for recording in the system labeling schedules generated by cable and asset management system.
  - 4. Save original manufacturer's containers and packing materials and deliver as directed under provisions covering extra materials.

### **1.11 PROJECT CONDITIONS**

- A. Environmental Conditions: System shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
  - 1. Interior, Controlled Environment: System components, except central-station control unit, installed in temperature-controlled interior environments shall be rated for continuous operation in ambient conditions of 2 to 50 deg C (36 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, non-condensing. NEMA 250, Type 1 enclosure.

2. Interior, Uncontrolled Environment: System components installed in non-temperature-controlled interior environments shall be rated for continuous operation in ambient conditions of -18 to 50 deg C (0 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, non-condensing. NEMA 250, Type 4X enclosures.
  3. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient conditions of -34 to 50 deg C (-30 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation where exposed to rain as specified in NEMA 250, winds up to 137 km/h (85 mph) and snow cover up to 610 mm (24 in) thick. NEMA 250, Type 4X enclosures.
- B. Security Environment: Use vandal resistant enclosures in high-risk areas where equipment may be subject to damage.

#### **1.12 EQUIPMENT AND MATERIALS**

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts shall be available.
- B. When more than one unit of the same class of equipment is required, such units shall be the product of a single manufacturer.
- C. Equipment Assemblies and Components:
  1. Components of an assembled unit need not be products of the same manufacturer.
  2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
  3. Components shall be compatible with each other and with the total assembly for the intended service.
  4. Constituent parts which are similar shall be the product of a single manufacturer.
- D. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.
- E. When Factory Testing Is Specified:
  1. The Government shall have the option of witnessing factory tests. The contractor shall notify the VA through the COR a minimum of 15 working days prior to the manufacturers making the factory tests.
  2. Four copies of certified test reports containing all test data shall be furnished to the COR prior to final inspection and not more than 90 days after completion of the tests.
  3. When equipment fails to meet factory test and re-inspection is required, the contractor shall be liable for all additional expenses, including expenses of the Government.

#### **1.13 ELECTRICAL POWER**

- A. Electrical power of 120 Volts Alternating Current (VAC) shall be indicated on the Division 26 drawings. Additional locations requiring primary power required by the security system shall be shown as part of these contract documents. Primary power for the security system shall be configured to switch to emergency backup sources automatically if interrupted without

degradation of any critical system function. Alarms shall not be generated as a result of power switching, however, an indication of power switching on (on-line source) shall be provided to the alarm monitor. The Security Contractor shall provide an interface (dry contact closure) between the PACS and the Uninterruptible Power Supply (UPS) system so the UPS trouble signals and main power fail appear on the PACS operator terminal as alarms.

- B. Failure of any on-line battery shall be detected and reported as a fault condition. Battery backed-up power supplies shall be provided sized for 8 hours of operation at actual connected load. Requirements for additional power or locations shall be included with the contract to support equipment and systems offered. The following minimum requirements shall be provided for power sources and equipment.

1. Emergency Generator
  - a. Intercom Stations
  - b. Outlets: Security Outlets dedicated to security equipment racks or security enclosure assemblies.
  - c. Security Device Power Supplies (DGP, VASS, Card Access, Lock Power, etc.) powered from the security closets or remotely: various locations
  - d. VASS Camera Power Supplies: Security Closets
  - e. VASS Pan/Tilt Units: Various Locations
  - f. VASS Outdoor Housing Heaters and Blowers: Various Sites
  - g. Intercom Master Control System

#### **1.14 TRANSIENT VOLTAGE SUPPRESSION, POWER SURGE SUPPLESION, & GROUNDING**

- A. Transient Voltage Surge Suppression: All cables and conductors extending beyond building façade, except fiber optic cables, which serve as communication, control, or signal lines shall be protected against Transient Voltage surges and have Transient Voltage Surge Suppression (TVSS) protection. The TVSS device shall be UL listed in accordance with Standard TIA 497B installed at each end. Lighting and surge suppression shall be a multi-strike variety and include a fault indicator. Protection shall be furnished at the equipment and additional triple solid state surge protectors rated for the application on each wire line circuit shall be installed within 914.4 mm (3 ft) of the building cable entrance. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode to verify there is no interference.
1. A 10-microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
  2. An 8-microsecond rise time by 20-microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.
  3. Maximum series current: 2 AMPS. Provide units manufactured by Advanced Protection Technologies, model # TE/FA 10B or TE/FA 20B.

4. Operating Temperature and Humidity: -40 to 85 deg C (-40 to 185 deg F), 0 to 95 percent relative humidity.

B. Grounding and Surge Suppression

1. The Security Contractor shall provide grounding and surge suppression to stabilize the voltage under normal operating conditions. To ensure the operation of over current devices, such as fuses, circuit breakers, and relays, underground-fault conditions.
2. Security Contractor shall engineer and provide proper grounding and surge suppression as required by local jurisdiction and prevailing codes and standards referenced in this document.
3. Principal grounding components and features. Include main grounding buses and grounding and bonding connections to service equipment.
4. Details of interconnection with other grounding systems. The lightning protection system shall be provided by the Security Contractor.
5. Locations and sizes of grounding conductors and grounding buses in electrical, data, and communication equipment rooms and closets.
6. AC power receptacles are not to be used as a ground reference point.
7. Any cable that is shielded shall require a ground in accordance with the best practices of the trade and manufactures installation instructions.
8. Protection should be provided at both ends of cabling.

**1.15 COMPONENT ENCLOSURES**

A. Construction of Enclosures

1. Consoles, power supply enclosures, detector control and terminal cabinets, control units, wiring gutters, and other component housings, collectively referred to as enclosures, shall be so formed and assembled as to be sturdy and rigid.
2. Thickness of metal in-cast and sheet metal enclosures of all types shall not be less than those in Tables I and II, UL 611. Sheet steel used in fabrication of enclosures shall be not less than 14 gauge. Consoles shall be 16-gauge.
3. Doors and covers shall be flanged. Enclosures shall not have pre-punched knockouts. Where doors are mounted on hinges with exposed pins, the hinges shall be of the tight pin type or the ends of hinge pins shall be tack welded to prevent removal. Doors having a latch edge length of less than 609.6 mm (24 in) shall be provided with a single construction core. Where the latch edge of a hinged door is more than 609.6 mm (24 in) or more in length, the door shall be provided with a three-point latching device with construction core; or alternatively with two, one located near each end.
4. Any ventilator openings in enclosures and cabinets shall conform to the requirements of UL 611. Unless otherwise indicated, sheet metal enclosures shall be designed for wall mounting with tip holes slotted. Mounting holes shall be in positions that remain accessible when all

- major operating components are in place and the door is open, but shall be in accessible when the door is closed.
5. Covers of pull and junction boxes provided to facilitate initial installation of the system shall be held in place by tamper proof Torx Center post security screws. Stenciled or painted labels shall be affixed to such boxes indicating they contain no connections. These labels shall not indicate the box is part of the Electronic Security System (ESS).
- B. Consoles & Equipment Racks: All consoles and vertical equipment racks shall include a forced air-cooling system to be provided by others.
1. Vertical Equipment Racks:
    - a. The forced air blowers shall be installed in the vented top of each cabinet and shall not reduce usable rack space.
    - b. The forced air fan shall consist of one fan rated at 105 CFM per rack bay and noise level shall not exceed 55 decibels.
    - c. Vertical equipment racks are to be provided with full sized clear plastic locking doors and vented top panels as shown on contract drawings.
- C. Tamper Provisions and Tamper Switches:
1. Enclosures, cabinets, housings, boxes and fittings or every product description having hinged doors or removable covers and which contain circuits, or the integrated security system and its power supplies shall be provided with cover operated, corrosion-resistant tamper switches.
  2. Tamper switches shall be arranged to initiate an alarm signal that will report to the monitoring station when the door or cover is moved. Tamper switches shall be mechanically mounted to maximize the defeat time when enclosure covers are opened or removed. It shall take longer than 1 second to depress or defeat the tamper switch after opening or removing the cover. The enclosure and tamper switch shall function together in such a manner as to prohibit direct line of sight to any internal component before the switch activates.
  3. Tamper switches shall be inaccessible until the switch is activated. Have mounting hardware concealed so the location of the switch cannot be observed from the exterior of the enclosure. Be connected to circuits which are under electrical supervision at all times, irrespective of the protection mode in which the circuit is operating. Be spring-loaded and held in the closed position by the door or cover and be wired so they break the circuit when the door cover is disturbed. Tamper circuits shall be adjustable type screw sets and shall be adjusted by the contractor to eliminate nuisance alarms associated with incorrectly mounted tamper device shall annunciate prior to the enclosure door opening (within 1/4 " tolerance. The tamper device or its components shall not be visible or accessible with common tools to bypass when the enclosure is in the secured mode.

4. The single gang junction boxes for the portrait alarming and pull boxes with less than 102 square mm will not require tamper switches.
5. All enclosures over 305 square mm shall be hinged with an enclosure lock.
6. Control Enclosures: Maintenance/Safety switches on control enclosures, which must be opened to make routing maintenance adjustments to the system and to service the power supplies, shall be push/pull-set automatic reset type.
7. Provide one (1) enclosure tamper switch for each 609 linear mm of enclosure lock side opening evenly spaced.
8. All security screws shall be Torx-Post Security Screws.
9. The contractor shall provide the owner with two (2) torx-post screwdrivers.

#### **1.16 ELECTRONIC COMPONENTS**

- A. All electronic components of the system shall be of the solid-state type, mounted on printed circuit boards conforming to UL 796. Boards shall be plug-in, quick-disconnect type. Circuitry shall not be so densely placed as to impede maintenance. All power-dissipating components shall incorporate safety margins of not less than 25 percent with respect to dissipation ratings, maximum voltages, and current-carrying capacity.

#### **1.17 SUBSTITUTE MATERIALS & EQUIPMENT**

- A. Where variations from the contract requirements are requested in accordance with the GENERAL CONDITIONS and Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.
- B. In addition to this Section the Security Contractor shall also reference Section II, Products and associated divisions. The COR shall have final authority on the authorization or refusal of substitutions. If there are no proposed substitutions, a statement in writing from the Contractor shall be submitted to the COR stating same. In the preparation of a list of substitutions, the following information shall be included, as a minimum:
  1. Identity of the material or devices specified for which there is a proposed substitution.
  2. Description of the segment of the specification where the material or devices are referenced.
  3. Identity of the proposed substitute by manufacturer, brand name, catalog or model number and the manufacturer's product name.
  4. A technical statement of all operational characteristic expressing equivalence to items to be substituted and comparison, feature-by-feature, between specification requirements and the material or devices called for in the specification; and Price differential.
- C. Materials Not Listed: Furnish all necessary hardware, software, programming materials, and supporting equipment required to place the specified major subsystems in full operation. Note that some supporting equipment, materials, and hardware may not be described herein.



Depending on the manufacturers selected by the COR, some equipment, materials and hardware may not be contained in either the Contract Documents or these written specifications, but are required by the manufacturer for complete operation according to the intent of the design and these specifications. In such cases, the COR shall be given the opportunity to approve the additional equipment, hardware and materials that shall be fully identified in the bid and in the equipment list submittal. The COR shall be consulted in the event there is any question about which supporting equipment, materials, or hardware is intended to be included.

- D. Response to Specification: The Contractor shall submit a point-by-point statement of compliance with each paragraph of the security specification. The statement of compliance shall list each paragraph by number and indicate "COMPLY" opposite the number for each paragraph where the Contractor fully complies with the specification. Where the proposed system cannot meet the requirements of the paragraph, and does not offer an equivalent solution, the offers shall indicate "DOES NOT COMPLY" opposite the paragraph number. Where the proposed system does not comply with the paragraph as written, but the bidder feels it will accomplish the intent of the paragraph in a manner different from that described, the offers shall indicate "COMPARABLE". The offers shall include a statement fully describing the "comparable" method of satisfying the requirement. Where a full and concise description is not provided, the offered system shall be considered as not complying with the specification. Any submission that does not include a point-by-point statement of compliance, as described above, shall be disqualified. Submittals for products shall be in precise order with the product section of the specification. Submittals not in proper sequence will be rejected.

#### **1.18 LIKE ITEMS**

- A. Where two or more items of equipment performing the same function are required, they shall be exact duplicates produced by one manufacturer. All equipment provided shall be complete, new, and free of any defects.

#### **1.19 WARRANTY**

- A. The Contractor shall, as a condition precedent to the final payment, execute a written guarantee (warranty) to the COR certifying all contract requirements have been completed according to the final specifications. Contract drawings and the warranty of all materials and equipment furnished under this contract are to remain in satisfactory operating condition (ordinary wear and tear, abuse and causes beyond his control for this work accepted) for one (1) year from the date the Contractor received written notification of final acceptance from the COR. Demonstration and training shall be performed prior to system acceptance. All defects or damages due to faulty materials or workmanship shall be repaired or replaced without delay, to the COR's satisfaction, and at the Contractor's expense. The Contractor shall provide quarterly inspections during the warranty period. The contractor shall provide written documentation to the COR on conditions and findings of the system and device(s). In addition, the contractor shall provide written

documentation of test results and stating what was done to correct any deficiencies. The first inspection shall occur 90 calendar days after the acceptance date. The last inspection shall occur 30 calendar days prior to the end of the warranty. The warranty period shall be extended until the last inspection and associated corrective actions are complete. When equipment and labor covered by the Contractor's warranty, or by a manufacturer's warranty, have been replaced or restored because of its failure during the warranty period, the warranty period for the replaced or repaired equipment or restored work shall be reinstated for a period equal to the original warranty period, and commencing with the date of completion of the replacement or restoration work. In the event any manufacturer customarily provides a warranty period greater than one (1) year, the Contractor's warranty shall be for the same duration for that component.

#### **1.20 SINGULAR NUMBER**

- A. Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

### **PART 2 – PRODUCTS**

#### **2.1 EQUIPMENT AND MATERIALS**

- A. All equipment associated within the Security Control Room, Security Console and Security Equipment Room shall be UL 827, UL 1981, and UL 60950 compliant and rated for continuous operation. Environmental conditions (i.e. temperature, humidity, wind, and seismic activity) shall be taken under consideration at each facility and site location prior to installation of the equipment.
- B. All equipment shall operate on a 120 or 240 volts alternating current (VAC); 50 Hz or 60 Hz AC power system unless documented otherwise in subsequent sections listed within this specification. All equipment shall have a back-up source of power that will provide a minimum of 8 hours of run time in the event of a loss of primary power to the facility.
- C. The system shall be designed, installed, and programmed in a manner that will allow for ease of operation, programming, servicing, maintenance, testing, and upgrading of the system.
- D. All equipment and materials for the system will be compatible to ensure correct operation.

#### **2.2 EQUIPMENT ITEMS**

- A. The Security Management System shall provide full interface with all components of the security subsystem as follows:
  - 1. Shall allow for communication between the Physical Access Control System and Database Management and all subordinate work and monitoring stations, enrollment centers for badging and biometric devices as part of the PACS, local annunciation centers, the electronic Security Management System (SMS), and all other VA redundant or backup command center or other workstations locations.

2. Shall provide automatic continuous communication with all systems that are monitored by the SMS, and shall automatically annunciate any communication failures or system alarms to the SMS operator providing identification of the system, nature of the alarm, and location of the alarm.
  3. Controlling devices shall be utilized to interface the SMS with all field devices.
- B. Wires and Cables:
1. Shall meet or exceed the manufactures recommendation for power and signals.
  2. Shall be carried in an enclosed conduit system, utilizing electromagnetic tubing (EMT) to include the equivalent in flexible metal, rigid galvanized steel (RGS) to include the equivalent of liquid tight, polyvinylchloride (PVC) schedule 40 or 80.
  3. All conduits will be sized and installed per the NEC. All security system signal and power cables that traverse or originate in a high security office space will contained in either EMT or RGS conduit.
  4. All conduit, pull boxes, and junction boxes shall be marked with colored permanent tape or paint that will allow it to be distinguished from all other infrastructure conduit.
  5. Conduit fills shall not exceed 50 percent unless otherwise documented.
  6. A pull string shall be pulled along and provided with signal and power cables to assist in future installations.
  7. At all locations where there is a wall penetration or core drilling is conducted to allow for conduit to be installed, fire stopping materials shall be applied to that area.
  8. High voltage and signal cables shall not share the same conduit and shall be kept separate up to the point of connection. High voltage for the security subsystems shall be any cable or sets of cables carrying 30 VDC/VAC or higher.
  9. For all equipment that is carrying digital data between the Security Control Room, Security Equipment Room, Security Console, or at a remote monitoring station, it shall not be less than 20 AWG and stranded copper wire for each conductor. The cable or each individual conductor within the cable shall have a shield that provides 100% coverage. Cables with a single overall shield shall have a tinned copper shield drain wire.

## **2.3 TRANSIENT VOLTAGE SURGE SUPPRESSION DEVICES (TVSS) AND SURGE SUPPRESION**

- A. Transient Voltage Surge Suppression
1. All cables and conductors extending beyond building perimeter, except fiber optic cables, which serve as communication, control, or signal lines shall be protected against Transient Voltage surges and have Transient Voltage surge suppression protection (TVSS) UL listed in accordance with Standard 497B installed at each end. Lightning and surge suppression shall be a multi-strike variety and include a fault indicator. Protection shall be furnished at the equipment and additional triple solid state surge protectors rated for the application on each wire line circuit shall be installed within 915 mm (36 in) of the building cable entrance. Fuses

shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode using the following waveforms:

- a. A 10-microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
- b. An 8-microsecond rise time by 20-microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.
- c. Maximum series current: 2 AMPS. Provide units manufactured by Advanced Protection Technologies, model # TE/FA 10B or TE/FA 20B or approved equivalent.
- d. Operating Temperature and Humidity: -40 to + 85 deg C (-40 to 185 deg F), and 0 to 95 percent relative humidity, non-condensing.

B. Physical Access Control Systems

1. Suppressors shall be installed on AC power at the point of service and shall meet the following criteria:
  - a. UL1449 2nd Edition, 2007, listed
  - b. UL1449 S.V.R. of 400 Volts or lower
  - c. Status Indicator Light(s)
  - d. Minimum Surge Current Capacity: 40,000 Amps (8 x 20  $\mu$ sec)
  - e. Maximum Continuous Current: 15 Amps
  - f. MCOV: 125 VAC
  - g. Service Voltage: 110-120 VAC
2. Suppressors shall be installed on the Low Voltage circuit at both the point of entrance and exit of the building. Suppressors shall meet the following criteria:
  - a. UL 497B
  - b. Minimum Surge Current Capacity: 2,000 Amps per pair
  - c. Maximum Continuous Current: 5 Amps
  - d. MCOV: 33 Volts
  - e. Service Voltage: 24Volts
3. Suppressors shall be installed on the communication circuit between the access controller and card reader at both the entrance and exit of the building. Suppressors shall meet the following criteria:
  - a. Conforms with UL497B standards (where applicable)
  - b. Clamp level for 12 and 24V power: 18VDC / 38VDC
  - c. Clamp level for Data/LED: 6.8VDC
  - d. Service Voltage for Power: 12VDC/24VDC
  - e. Service Voltage for Data/LED: <5VDC
  - f. Clamp level – PoE Access Power: 72V
  - g. Clamp level – PoE Access Data: 7.9V

- h. Service Voltage – PoE Access: 48VAC – 54VAC
- i. Service Voltage – PoE Data: <5VDC

C. Intercom Systems

1. Suppressors shall be installed on the AC power at the point of service and shall meet the following criteria:
  - a. UL 1449 Listed
  - b. UL 1449 S.V.R. of 400 Volts or lower
  - c. Diagnostic Indicator Light(s)
  - d. Integrated ground terminating post (where case/chassis ground exists)
  - e. Minimum Surge Current Capacity of 13,000 Amps (8 x 20  $\mu$ Sec)
2. Suppressors shall be installed on incoming central office lines and shall meet the following criteria:
  - a. UL 497A Listed
  - b. Multi Stage protection design
  - c. Auto-reset current protection not to exceed 2 Amps per pair
  - d. Minimum Surge Current of 500 Amps per pair (8 x 20  $\mu$ Sec)
3. Suppressors shall be installed on all telephone/intercom circuits that enter or leave separate buildings and shall meet the following criteria:
  - a. UL 497A Listed (where applicable)
  - b. UL 497B Listed (horns, strobes, speakers or communication circuits over 300 feet)
  - c. Multi Stage protection design
  - d. Auto-reset over-current protection not to exceed 5 Amps per pair
  - e. Minimum Surge Current of 1000 Amps per pair (8 x 20  $\mu$ Sec)

D. Intrusion Detection Systems

1. Suppressors shall be installed on AC at the point of service and shall meet the following criteria:
  - a. UL 1449, 2nd Edition 2007, listed
  - b. UL 1449 S.V.R. of 400 Volts or lower
  - c. Status Indicator Lights
  - d. Center screw for terminating Class II transformers
  - e. Minimum Surge Current Capacity of 32,000 Amps (8 x 20  $\mu$ Sec)
2. Suppressors shall be installed on all Telephone Communication Interface circuits and shall meet the following criteria:
  - a. UL 497A Listed
  - b. Multi Stage protection design
  - c. Surge Current Capacity: 9,000 Amps (8x20  $\mu$ Sec)
  - d. Clamp Voltage: 130Vrms

- e. Auto reset current protection not to exceed 150 milliAmps
- 3. Suppressors shall be installed on all burglar alarm initiating and signaling loops and addressable circuits which enter or leave separate buildings. The following criteria shall be met:
  - a. UL 497B for data communications or annunciation (powered loops)
  - b. Fail-short/fail-safe mode.
  - c. Surge Current Capacity: 9,000 Amps (8x20  $\mu$ Sec)
  - d. Clamp Voltage: 15 Vrms
  - e. Joule Rating: 76 Joules per pair (10x1000  $\mu$ Sec)
  - f. Auto-reset current protection not to exceed 150 milliAmps for UL 497A devices.
- E. Video Surveillance System
  - 1. Protectors shall be installed on coaxial cable systems on points of entry and exit from separate buildings. Suppressors shall be installed at each exterior camera location and include protection for 12 and/or 24 volt power, data signal and motor controls (for Pan, Tilt and Zoom systems). SPDs shall protect all modes herein mentioned and contain all modes in a single unit system. Protection for all systems mentioned above shall be incorporated at the head end equipment. Additionally a minimum 450VA battery backup shall be used to protect the DVR or VCR and monitor. Protectors shall meet the following criteria:
    - a. Head-End Power
      - 1) UL 1778, cUL (Battery Back Up)
      - 2) Minimum Surge Current Capacity: 65,000 Amps (8x20 $\mu$ sec)
      - 3) Minimum of two (2) NEMA 5-15R Receptacles (one (1) AC power only, one (1) with UPS)
      - 4) All modes protected (L-N, L-G, N-G)
      - 5) EMI/RFI Filtering
      - 6) Maximum Continuous Current: 12 Amps
    - b. Camera Power
      - 1) Minimum Surge Current Capacity: 1,000 Amps (8X20 $\mu$ sec); 240 Amps for IP Video/PoE cameras
      - 2) Screw Terminal Connection
      - 3) All protection modes L-G (all Lines)
      - 4) MCOV <40VAC
    - c. Video And Data
      - 1) Surge Current Capacity 1,000 Amps per conductor
      - 2) "BNC" Connection (Coax)
      - 3) Protection modes: L-G (Data), Center Pin-G, Shield-G (Coax)
      - 4) Band Pass 0-2GHz

5) Insertion Loss <0.3dB

F. Grounding and Surge Suppression

1. The Security Contractor shall provide grounding and surge suppression to stabilize the voltage under normal operating conditions. This is to ensure the operation of over current devices, such as fuses, circuit breakers, and relays, underground-fault conditions.
2. The Contractor shall engineer, provide, and install proper grounding and surge suppression as required by local jurisdiction and prevailing codes and standards, referenced in this document.
3. Principal grounding components and features shall include: main grounding buses, grounding, and bonding connections to service equipment.
4. The Contractor shall provide detail drawings of interconnection with other grounding systems including lightning protection systems.
5. The Contractor shall provide details of locations and sizes of grounding conductors and grounding buses in electrical, data, and communication equipment rooms and closets.
6. AC power receptacles are not to be used as a ground reference point.
7. Any cable that is shielded shall require a ground in accordance with applicable codes, the best practices of the trade, and all manufacturers' installation instructions.

G. 120 VAC Surge Suppression

1. Continuous Current: Unlimited (parallel connection)
2. Max Surge Current: 13,500 Amps
3. Protection Modes: L - N, L - G, N - G
4. Warranty: Ten Year Limited Warranty
5. Dimension: 73.7 x 41.1 x 52.1 mm (2.90 x 1.62 x 2.05 in)
6. Weight: 2.88 g (0.18 lbs)
7. Housing: ABS

**2.4 INSTALLATION KIT**

A. General:

1. The kit shall be provided that, at a minimum, includes all connectors and terminals, labeling systems, audio spade lugs, barrier strips, punch blocks or wire wrap terminals, heat shrink tubing, cable ties, solder, hangers, clamps, bolts, conduit, cable duct, and/or cable tray, etc., required to accomplish a neat and secure installation. All wires shall terminate in a spade lug and barrier strip, wire wrap terminal or punch block. Unfinished or unlabeled wire connections shall not be allowed. All unused and partially opened installation kit boxes, coaxial, fiber-optic, and twisted pair cable reels, conduit, cable tray, and/or cable duct bundles, wire rolls, physical installation hardware shall be turned over to the Contracting Officer. The following sections outline the minimum required installation sub-kits to be used:
2. System Grounding:

- a. The grounding kit shall include all cable and installation hardware required. All head end equipment and power supplies shall be connected to earth ground via internal building wiring, according to the NEC.
  - b. This includes, but is not limited to:
    - 1) Coaxial Cable Shields
    - 2) Control Cable Shields
    - 3) Data Cable Shields
    - 4) Equipment Racks
    - 5) Equipment Cabinets
    - 6) Conduits
    - 7) Cable Duct blocks
    - 8) Cable Trays
    - 9) Power Panels
    - 10) Grounding
    - 11) Connector Panels
3. Coaxial Cable: The coaxial cable kit shall include all coaxial connectors, cable tying straps, heat shrink tabbing, hangers, clamps, etc., required to accomplish a neat and secure installation.
4. Wire and Cable: The wire and cable kit shall include all connectors and terminals, audio spade lugs, barrier straps, punch blocks, wire wrap strips, heat shrink tubing, tie wraps, solder, hangers, clamps, labels etc., required to accomplish a neat and orderly installation.
5. Conduit, Cable Duct, and Cable Tray: The kit shall include all conduit, duct, trays, junction boxes, back boxes, cover plates, feed through nipples, hangers, clamps, other hardware required to accomplish a neat and secure conduit, cable duct, and/or cable tray installation in accordance with the NEC and this document.
6. Equipment Interface: The equipment kit shall include any item or quantity of equipment, cable, mounting hardware and materials needed to interface the systems with the identified sub-system(s) according to the OEM requirements and this document.
7. Labels: The labeling kit shall include any item or quantity of labels, tools, stencils, and materials needed to label each subsystem according to the OEM requirements, as-installed drawings, and this document.
8. Documentation: The documentation kit shall include any item or quantity of items, computer discs, as installed drawings, equipment, maintenance, and operation manuals, and OEM materials needed to provide the system documentation as required by this document and explained herein.



## **PART 3 – EXECUTION**

### **3.1 COMMON REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATION**

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electronic safety and security equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.
- F. Equipment location shall be as close as practical to locations shown on the drawings.
- G. Inaccessible Equipment:
  - 1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.
  - 2. "Conveniently accessible" is defined as being capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

### **3.2 FIRESTOPPING**

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electronic safety and security installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section 07 84 00 "FIRESTOPPING."

### **3.3 DEMONSTRATION AND TRAINING**

- A. Training shall be provided in accordance with Article, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.
- B. Training shall be provided for the particular equipment or system as required in each associated specification.
- C. A training schedule shall be developed and submitted by the contractor and approved by the COR at least 30 days prior to the planned training.
- D. Provide services of manufacturer's technical representative for 8 hours to instruct VA personnel in operation and maintenance of units.

### **3.4 WORK PERFORMANCE**

- A. Job site safety and worker safety is the responsibility of the contractor.

- B. For work on existing stations, arrange, phase and perform work to assure electronic safety and security service for other buildings at all times. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.
- C. New work shall be installed and connected to existing work neatly and carefully. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.
- D. Coordinate location of equipment and conduit with other trades to minimize interferences. See the GENERAL CONDITIONS.

### **3.5 SYSTEM PROGRAMMING**

- A. General Programming Requirements
  - 1. This following section shall be used by the contractor to identify the anticipated level of effort (LOE) required setup, program, and configure the Electronic Security System (ESS). The contractor shall be responsible for providing all setup, configuration, and programming to include data entry for the Security Management System (SMS) and subsystems [(e.g., video matrix switch, intercoms, digital video recorders, intrusion devices, including integration of subsystems to the SMS (e.g., camera call up, time synchronization, intercoms)]. System programming for existing or new SMS servers shall not be conducted at the project site.
- B. Level of Effort for Programming
  - 1. The Contractor shall perform and complete system programming (including all data entry) at an offsite location using the Contractor's own copy of the SMS software. The Contractor's copy of the SMS software shall be of the Owners current version. Once system programming has been completed, the Contractor shall deliver the data to the COR on data entry forms and an approved electronic medium, utilizing data from the contract documents. The completed forms shall be delivered to the COR for review and approval at least 90 calendar days prior to the scheduled date the Contractor requires it. The Contractor shall not upload system programming until the COR has provided written approval. The Contractor is responsible for backing up the system prior to uploading new programming data. Additional programming requirements are provided as follows:
    - a. Programming for Existing SMS Servers: The contractor shall perform all related system programming except for personnel data as noted. The contractor will not be responsible for uploading personnel information (e.g., ID Cards backgrounds, names, access privileges, access schedules, personnel groupings). The contractor shall anticipate a weekly coordination meeting and working alongside of COR to ensure data uploading is performed without incident of loss of function or data loss. System programming for SMS servers shall be performed by using the Contractor's own server and software. These servers shall not be connected to existing devices or systems at any time.

2. The Contractor shall identify and request from the COR, any additional data needed to provide a complete and operational system as described in the contract documents.
3. Contractor and COR coordination on programming requires a high level of coordination to ensure programming is performed in accordance with VA requirements and programming uploads do not disrupt existing systems functionality. The contractor shall anticipate a minimum a weekly coordination meeting. Contractor shall ensure data uploading is performed without incident of loss of function or data loss. The following Level of Effort Chart is provided to communicate the expected level of effort required by contractors on VA ESS projects. Calculations to determine actual levels of effort shall be confirmed by the contractor before project award.

### **3.6 TESTING AND ACCEPTANCE**

#### **A. Performance Requirements**

##### **1. General:**

- a. The Contractor shall perform contract field, performance verification, and endurance testing and make adjustments of the completed security system when permitted. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all testing. Written notification of planned testing shall be given to the COR at least 60 calendar days prior to the test and after the Contractor has received written approval of the specific test procedures.
  - b. The COR shall witness all testing and system adjustments during testing. Written permission shall be obtained from the COR before proceeding with the next phase of testing. Original copies of all data produced during performance verification and endurance testing shall be turned over to the COR at the conclusion of each phase of testing and prior to COR approval of the test.
2. Test Procedures and Reports: The test procedures, compliant w/ VA standard test procedures, shall explain in detail, step-by-step actions and expected results demonstrating compliance with the requirements of the specification. The test reports shall be used to document results of the tests. The reports shall be delivered to the COR within seven (7) calendar days after completion of each test.

#### **B. The inspection and test will be conducted by a factory-certified contractor representative and witnessed by a Government Representative. The results of the inspection will be officially recorded by a designated Government Representative and maintained on file by the COR, until completion of the entire project. The results will be compared to the Acceptance Test results.**

#### **C. Contractor's Field Testing (CFT)**

1. The Contractor shall calibrate and test all equipment, verify DTM operation, place the integrated system in service, and test the integrated system. Ground rods installed by this Contractor within the base of camera poles shall be tested as specified in IEEE STD 142.

The Contractor shall test all security systems and equipment, and provide written proof of a 100% operational system before a date is established for the system acceptance test. Documentation package for CFT shall include completed (fully annotated details of test details) for each device and system tested, and annotated loading sheets documenting complete testing to COR approval. CFT test documentation package shall conform to submittal requirements outlined in this Section. The Contractor's field testing procedures shall be identical to the COR's acceptance testing procedures. The Contractor shall provide the COR with a written listing of all equipment and software indicating all equipment and components have been tested and passed. The Contractor shall deliver a written report to the COR stating the installed complete system has been calibrated, tested, and is ready to begin performance verification testing; describing the results of the functional tests, diagnostics, and calibrations; and the report shall also include a copy of the approved acceptance test procedure. Performance verification testing shall not take place until written notice by contractor is received certifying that a contractors field test was successful.

D. Performance Verification Test (PVT)

1. Test team:
  - a. After the system has been pretested and the Contractor has submitted the pretest results and certification to the COR, then the Contractor shall schedule an acceptance test to date and give the COR written, notice as described herein, prior to the date the acceptance test is expected to begin. The system shall be tested in the presence of a Government Representative, an OEM certified representative, representative of the Contractor and other approved by the COR. The system shall be tested utilizing the approved test equipment to certify proof of performance, FCC, UL and Emergency Service compliance. The test shall verify that the total system meets all the requirements of this specification. The notification of the acceptance test shall include the expected length (in time) of the test.
2. The Contractor shall demonstrate the completed Physical Access Control System PACS complies with the contract requirements. In addition, the Contractor shall provide written certification that the system is 100% operational prior to establishing a date for starting PVT. Using approved test procedures, all physical and functional requirements of the project shall be demonstrated and shown. The PVT will be stopped and aborted as soon as 10 technical deficiencies are found requiring correction. The Contractor shall be responsible for all travel and lodging expenses incurred for out-of-town personnel required to be present for resumption of the PVT. If the acceptance test is aborted, the re-test will commence from the beginning with a retest of components previously tested and accepted.
3. The PVT, as specified, shall not begin until receipt of written certification that the Contractors Field Testing was successful. This shall include certification of successful completion of

testing as specified in paragraph "Contractor's Field Testing", and upon successful completion of testing at any time when the system fails to perform as specified. Upon termination of testing by the COR or Contractor, the Contractor shall commence an assessment period as described for Endurance Testing Phase II.

4. Upon successful completion of the acceptance test, the Contractor shall deliver test reports and other documentation, as specified, to the COR prior to commencing the endurance test.
5. Additional Components of the PVT shall include:
  - a. System Inventory
    - 1) All Device equipment
    - 2) All Software
    - 3) All Logon and Passwords
    - 4) All Cabling System Matrices
    - 5) All Cable Testing Documents
    - 6) All System and Cabinet Keys
  - b. Inspection
    - 1) Contractor shall record an inspection punch list noting all system deficiencies. The contractor shall prepare an inspection punch list format for CORs approval.
    - 2) As a minimum the punch list shall include a listing of punch list items, punch list item location, description of item problem, date noted, date corrected, and details of how item was corrected.
6. Partial PVT - At the discretion of COR, the Performance Verification Test may be performed in part should a 100% compliant CFT be performed. In the event that a partial PVT will be performed instead of a complete PVT; the partial PVT shall be performed by testing 10% of the system. The contractor shall perform a test of each procedure on select devices or equipment.

E. Exclusions

1. The Contractor will not be held responsible for failures in system performance resulting from the following:
  - a. An outage of the main power in excess of the capability of any backup power source provided the automatic initiation of all backup sources was accomplished and that automatic shutdown and restart of the PACS performed as specified.
  - b. Failure of an Owner furnished equipment or communications link, provided the failure was not due to Contractor furnished equipment, installation, or software.
  - c. Failure of existing Owner owned equipment, provided the failure was not due to Contractor furnished equipment, installation, or software.

--- E N D ---

**SECTION 28 31 00  
FIRE DETECTION AND ALARM**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. **The voice/alarm and mass notification fire alarm system shall be manufactured by Simplex Grinnell and tied into the existing central station system. System graphics shall be updated at completion of project. All work required to expand/extend existing networked system shall be included/provided.**
- B. This section of the specifications includes the furnishing, installation, and connection of the fire alarm equipment to form a complete coordinated system ready for operation. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, control units, fire safety control devices, annunciators, power supplies, and wiring as shown on the drawings and specified. The fire alarm system shall not be combined with other systems such as building automation, energy management, security, etc.
- C. Fire alarm systems shall comply with requirements of the most recent VA FIRE PROTECTION DESIGN MANUAL and NFPA 72 unless variations to NFPA 72 are specifically identified within these contract documents by the following notation: "variation". The design, system layout, document submittal preparation, and supervision of installation and testing shall be provided by a technician that is certified NICET level III or a registered fire protection engineer. The NICET certified technician shall be on site for the supervision and testing of the system. Factory engineers from the equipment manufacturer, thoroughly familiar and knowledgeable with all equipment utilized, shall provide additional technical support at the site as required by the COR or his authorized representative. Installers shall have a minimum of 2 years' experience installing fire alarm systems.
- D. Fire alarm signals:
  - 1. Building 31 shall have a general evacuation fire alarm signal in accordance with ASA S3.41 to notify all occupants in the respective building to evacuate.
- E. Alarm signals (by device), supervisory signals (by device) and system trouble signals (by device not reporting) shall be distinctly transmitted to the main fire alarm system control unit located in the security office fire department. Graphics monitoring PC's are located in Building 18, Security office and the Fire Department located in Building 21.
- F. The main fire alarm control unit shall automatically transmit alarm signals to a listed central station using a digital alarm communicator transmitter in accordance with NFPA 72.

**1.2 SCOPE**

- A. A fully addressable fire alarm system shall be designed and installed in accordance with the specifications and drawings. Device location and wiring runs shown on the drawings are for

reference only unless specifically dimensioned. Actual locations shall be in accordance with NFPA 72 and this specification.

- B. All existing fire alarm equipment, wiring, devices and sub-systems that are not shown to be reused shall be removed. All existing fire alarm conduit not reused shall be removed.
- C. Existing fire alarm bells, chimes, door holders, 120VAC duct smoke detectors, valve tamper switches and waterflow/pressure switches may be reused only as specifically indicated on the drawings and provided the equipment:
  - 1. Meets this specification section
  - 2. Is UL listed or FM approved
  - 3. Is compatible with new equipment being installed
  - 4. Is verified as operable through contractor testing and inspection
  - 5. Is warranted as new by the contractor.
- D. Existing 120 VAC duct smoke detectors, waterflow/pressure switches, and valve tamper switches reused by the Contractor shall be equipped with an addressable interface device compatible with the new equipment being installed.
- E. Existing reused equipment shall be covered as new equipment under the Warranty specified herein.
- F. Basic Performance:
  - 1. Alarm and trouble signals from each building fire alarm control panel shall be digitally encoded by UL listed electronic devices onto a multiplexed communication system.
  - 2. Response time between alarm initiation (contact closure) and recording at the main fire alarm control unit (appearance on alphanumeric read out) shall not exceed 5 seconds.
  - 3. The signaling line circuits (SLC) between building fire alarm control units shall be wired Style 7 in accordance with NFPA 72. Isolation shall be provided so that no more than one building can be lost due to a short circuit fault.
  - 4. Initiating device circuits (IDC) shall be wired Style C in accordance with NFPA 72.
  - 5. Signaling line circuits (SLC) within buildings shall be wired Style 4 in accordance with NFPA 72. Individual signaling line circuits shall be limited to covering 22,500 square feet (2,090 square meters) of floor space or 3 floors whichever is less.
  - 6. Notification appliance circuits (NAC) shall be wired Style Y in accordance with NFPA 72.

### **1.3 RELATED WORK**

- A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.  
Requirements for procedures for submittals.
- B. Section 07 84 00 - FIRESTOPPING. Requirements for fire proofing wall penetrations.
- C. Section 26 05 33 – RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS. Requirements for infrastructure.

#### 1.4 SUBMITTALS

- A. General: Submit 5 copies in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, and Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Drawings:
  - 1. Prepare drawings using AutoCAD Release 14 software and include all contractors' information. Layering shall be by VA criteria as provided by the Contracting Officer's Representative (COR). Bid drawing files on AutoCAD 2016 will be provided to the Contractor at the pre-construction meeting. The contractor shall be responsible for verifying all critical dimensions shown on the drawings provided by VA.
  - 2. Floor plans: Provide locations of all devices (with device number at each addressable device corresponding to control unit programming), appliances, panels, equipment, junction/terminal cabinets/boxes, risers, electrical power connections, individual circuits and raceway routing, system zoning; number, size, and type of raceways and conductors in each raceway; conduit fill calculations with cross section area percent fill for each type and size of conductor and raceway. Only those devices connected and incorporated into the final system shall be on these floor plans. Do not show any removed devices on the floor plans. Show all interfaces for all fire safety functions.
  - 3. Riser diagrams: Provide, for the entire system, the number, size and type of riser raceways and conductors in each riser raceway and number of each type device per floor and zone. Show door holder interface, elevator control interface, HVAC shutdown interface, fire extinguishing system interface, and all other fire safety interfaces. Show wiring Schedules on the riser diagram for all circuits. Provide diagrams both on a per building and campus wide basis.
  - 4. Detailed wiring diagrams: Provide for control panels, modules, power supplies, electrical power connections, auxiliary relays and annunciators showing termination identifications, size and type conductors, circuit boards, LED lamps, indicators, adjustable controls, switches, ribbon connectors, wiring harnesses, terminal strips and connectors, spare zones/circuits. Diagrams shall be drawn to a scale sufficient to show spatial relationships between components, enclosures and equipment configuration.
  - 5. Two weeks prior to final inspection, the Contractor shall deliver to the COR 3 sets of as-built drawings and one set of the as-built drawing computer files (using AutoCAD 2007 or later). As-built drawings (floor plans) shall show all new and/or existing conduit used for the fire alarm system.
- C. Manuals:
  - 1. Submit simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals including technical data sheets for all items used in the system, power



- requirements, device wiring diagrams, dimensions, and information for ordering replacement parts.
- a. Wiring diagrams shall have their terminals identified to facilitate installation, operation, expansion and maintenance.
  - b. Wiring diagrams shall indicate internal wiring for each item of equipment and the interconnections between the items of equipment.
  - c. Include complete listing of all software used and installation and operation instructions including the input/output matrix chart.
  - d. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate, inspect, test and maintain the equipment and system. Provide all manufacturer's installation limitations including but not limited to circuit length limitations.
  - e. Provide standby battery calculations under normal operating and alarm modes. Battery calculations shall include the magnets for holding the doors open for one minute.
  - f. Include information indicating who will provide emergency service and perform post contract maintenance.
  - g. Provide a replacement parts list with current prices. Include a list of recommended spare parts, tools, and instruments for testing and maintenance purposes.
  - h. A computerized preventive maintenance schedule for all equipment. The schedule shall be provided on disk in a computer format acceptable to the VAMC and shall describe the protocol for preventive maintenance of all equipment. The schedule shall include the required times for systematic examination, adjustment and cleaning of all equipment. A print out of the schedule shall also be provided in the manual. Provide the disk in a pocket within the manual.
  - i. Furnish manuals in 3 ring loose-leaf binder or manufacturer's standard binder.
  - j. A print out for all devices proposed on each signaling line circuit with spare capacity indicated.
2. Two weeks prior to final inspection, deliver 4 copies of the final updated maintenance and operating manual to the COR.
    - a. The manual shall be updated to include any information necessitated by the maintenance and operating manual approval.
    - b. Complete "As installed" wiring and schematic diagrams shall be included that shows all items of equipment and their interconnecting wiring. Show all final terminal identifications.
    - c. Complete listing of all programming information, including all control events per device including an updated input/output matrix.
    - d. Certificate of Installation as required by NFPA 72 for each building. The certificate shall identify any variations from the National Fire Alarm Code.

- e. Certificate from equipment manufacturer assuring compliance with all manufacturers installation requirements and satisfactory system operation.
- D. Certifications:
  - 1. Together with the shop drawing submittal, submit the technician's NICET level III fire alarm certification as well as certification from the control unit manufacturer that the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include in the certification the names and addresses of the proposed supervisor of installation and the proposed performer of contract maintenance. Also include the name and title of the manufacturer's representative who makes the certification.
  - 2. Together with the shop drawing submittal, submit a certification from either the control unit manufacturer or the manufacturer of each component (e.g., smoke detector) that the components being furnished are compatible with the control unit.
  - 3. Together with the shop drawing submittal, submit a certification from the major equipment manufacturer that the wiring and connection diagrams meet this specification, UL and NFPA 72 requirements.

## **1.5 WARRANTY**

- A. All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of one year from the date of acceptance of the entire installation by the Contracting Officer.

## **1.6 APPLICABLE PUBLICATIONS**

- A. The publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. The publications are referenced in text by the basic designation only and the latest editions of these publications shall be applicable.
- B. National Fire Protection Association (NFPA):
  - NFPA 13 .....Standard for the Installation of Sprinkler Systems, 2010 edition
  - NFPA 14 ..... Standard for the Installation of Standpipes and Hose Systems, 2010 edition
  - NFPA 20 ..... Standard for the Installation of Stationary Pumps for Fire Protection, 2010 edition
  - NFPA 70.....National Electrical Code (NEC), 2014 edition
  - NFPA 72.....National Fire Alarm Code, 2010 edition
  - NFPA 90A ..... Standard for the Installation of Air Conditioning and Ventilating Systems, 2009 edition
  - NFPA 101.....Life Safety Code, 2009 edition
- C. Underwriters Laboratories, Inc. (UL): Fire Protection Equipment Directory
- D. Factory Mutual Research Corp (FM): Approval Guide, 2007-2011
- E. American National Standards Institute (ANSI):

S3.41 .....Audible Emergency Evacuation Signal, 1990 edition, reaffirmed  
2008

F. International Code Council, International Building Code (IBC), 2009 edition

## **PART 2 - PRODUCTS**

### **2.1 EQUIPMENT AND MATERIALS, GENERAL**

- A. Existing equipment may be reused only where indicated on the drawings.
- B. Except as indicated in paragraph A, all equipment and components shall be new and the manufacturer's current model. All equipment shall be tested and listed by Underwriters Laboratories, Inc. or Factory Mutual Research Corporation for use as part of a fire alarm system. The authorized representative of the manufacturer of the major equipment shall certify that the installation complies with all manufacturers' requirements and that satisfactory total system operation has been achieved.

### **2.2 CONDUIT, BOXES, AND WIRE**

- A. Conduit shall be in accordance with Section 26 05 33 RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS and as follows:
  - 1. All new conduits shall be installed in accordance with NFPA 70.
  - 2. Conduit fill shall not exceed 40 percent of interior cross sectional area.
  - 3. All new conduits shall be 3/4 inch (19 mm) minimum.
- B. Wire:
  - 1. Wiring shall be in accordance with NEC article 760 and as recommended by the manufacturer of the fire alarm system. All wires shall be color coded. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG for initiating device circuits and 14 AWG for notification device circuits.
  - 2. Wiring shall be in accordance with NEC article 760, Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES, and as recommended by the manufacturer of the fire alarm system. All wires shall be color coded. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG for initiating device circuits and 14 AWG for notification device circuits.
  - 3. Addressable circuits and wiring used for the multiplex communication loop shall be twisted and shielded unless specifically accepted by the fire alarm equipment manufacturer in writing.
  - 4. Any fire alarm system wiring that extends outside of a building shall have additional power surge protection to protect equipment from physical damage and false signals due to lightning, voltage and current induced transients. Protection devices shall be shown on the submittal drawings and shall be UL listed or in accordance with written manufacturer's requirements.
  - 5. All wire or cable used in underground conduits including those in concrete shall be listed for wet locations.

C. Terminal Boxes, Junction Boxes, and Cabinets:

1. Shall be galvanized steel in accordance with UL requirements.
2. All boxes shall be sized and installed in accordance with NFPA 70.
3. covers shall be repainted red in accordance with Section 09 91 00, PAINTING and shall be identified with white markings as "FA" for junction boxes and as "FIRE ALARM SYSTEM" for cabinets and terminal boxes. Lettering shall be a minimum of 3/4 inch (19 mm) high.
4. Terminal boxes and cabinets shall have a volume 50 percent greater than required by the NFPA 70. Minimum sized wire shall be considered as 14 AWG for calculation purposes.
5. Terminal boxes and cabinets shall have identified pressure type terminal strips and shall be located at the base of each riser. Terminal strips shall be labeled as specified or as approved by the COR.

**2.3 FIRE ALARM CONTROL UNIT**

A. General:

1. The existing Simplex 4100U fire alarm control panel shall be extended/expanded as required to accommodate additional devices.
2. Each power source shall be supervised from the other source for loss of power.
3. All circuits shall be monitored for integrity.
4. Visually and audibly annunciate any trouble condition including, but not limited to main power failure, grounds and system wiring derangement.
5. Transmit digital alarm information to the main fire alarm control unit.

B. Enclosure:

1. The control unit shall be housed in a cabinet suitable for both recessed and surface mounting. Cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish.
2. Cabinet shall contain all necessary relays, terminals, lamps, and legend plates to provide control for the system.

C. Power Supply:

1. The control unit shall derive its normal power from a 120 volt, 60 Hz dedicated supply connected to the emergency power system. Standby power shall be provided by a 24 volt DC battery as hereinafter specified. The normal power shall be transformed, rectified, coordinated, and interfaced with the standby battery and charger.
2. The door holder power shall be arranged so that momentary or sustained loss of main operating power shall not cause the release of any door.
3. Power supply for smoke detectors shall be taken from the fire alarm control unit.
4. Provide protectors to protect the fire alarm equipment from damage due to lightning or voltage and current transients.

5. Provide new separate and direct ground lines to the outside to protect the equipment from unwanted grounds.
- D. Circuit Supervision: Each alarm initiating device circuit, signaling line circuit, and notification appliance circuit, shall be supervised against the occurrence of a break or ground fault condition in the field wiring. These conditions shall cause a trouble signal to sound in the control unit until manually silenced by an off switch.
- E. Supervisory Devices: All sprinkler system valves, standpipe control valves, post indicator valves (PIV), and main gate valves shall be supervised for off-normal position. Closing a valve shall sound a supervisory signal at the control unit until silenced by an off switch. The specific location of all closed valves shall be identified at the control unit. Valve operation shall not cause an alarm signal. Low air pressure switches and duct detectors shall be monitored as supervisory signals. The power supply to the elevator shunt trip breaker shall be monitored by the fire alarm system as a supervisory signal.
- F. Trouble signals:
  1. Arrange the trouble signals for automatic reset (non-latching).
  2. System trouble switch off and on lamps shall be visible through the control unit door.
- G. Function Switches: Provide the following switches in addition to any other switches required for the system:
  1. Remote Alarm Transmission By-pass Switch: Shall prevent transmission of all signals to the main fire alarm control unit when in the "off" position. A system trouble signal shall be energized when switch is in the off position.
  2. Alarm Off Switch: Shall disconnect power to alarm notification circuits on the local building alarm system. A system trouble signal shall be activated when switch is in the off position.
  3. Trouble Silence Switch: Shall silence the trouble signal whenever the trouble silence switch is operated. This switch shall not reset the trouble signal.
  4. Reset Switch: Shall reset the system after an alarm, provided the initiating device has been reset. The system shall lock in alarm until reset.
  5. Lamp Test Switch: A test switch or other approved convenient means shall be provided to test the indicator lamps.
  6. Drill Switch: Shall activate all notification devices without tripping the remote alarm transmitter. This switch is required only for general evacuation systems specified herein.
  7. Door Holder By-Pass Switch: Shall prevent doors from releasing during fire alarm tests. A system trouble alarm shall be energized when switch is in the abnormal position.
  8. Elevator recall By-Pass Switch: Shall prevent the elevators from recalling upon operation of any of the devices installed to perform that function. A system trouble alarm shall be energized when the switch is in the abnormal position.

9. HVAC/Smoke Damper By-Pass: Provide a means to disable HVAC fans from shutting down and/or smoke dampers from closing upon operation of an initiating device designed to interconnect with these devices.
- H. Remote Transmissions:
  1. Provide capability and equipment for transmission of alarm, supervisory and trouble signals to the main fire alarm control unit.
  2. Transmitters shall be compatible with the systems and equipment they are connected to such as timing, operation and other required features.
- I. Remote Control Capability: Each building fire alarm control unit shall be installed and programmed so that each must be reset locally after an alarm, before the main fire alarm control unit can be reset. After the local building fire alarm control unit has been reset, then the all system acknowledge, reset, silence or disabling functions can be operated by the main fire alarm control unit
- J. System Expansion: Design the control units and enclosures so that the system can be expanded in the future (to include the addition of 20 percent more alarm initiating, alarm notification and door holder circuits) without disruption or replacement of the existing control unit and secondary power supply.
- K. Network interface card shall be a fiber optic media card with transmit/receive capabilities for connecting new and existing control panels, network integrator panels, etc. to the fiber backbone/graphics system. Network interface card shall be 62.5/125 micron fiber to match specified backbone. Simplex #4100-6057.

## **2.4 ALARM NOTIFICATION APPLIANCES**

- A. Speakers:
  1. Shall operate on either 25 VRMS or 70.7 VRMS with field selectable output taps from 0.5 to 2.0W and originally installed at the 1/2 watt tap. Speakers shall provide a minimum sound output of 80 dBA at 10 feet (3,000 mm) with the 1/2 watt tap.
  2. Frequency response shall be a minimum of 400 HZ to 4,000 HZ.
  3. Four inches (100 mm) or 8 inches (200 mm) cone type speakers ceiling mounted with white colored baffles in areas with suspended ceilings and wall mounted in areas without ceilings.
- B. Strobes:
  1. Xenon flash tube type minimum 15 candela in toilet rooms and 75 candela in all other areas with a flash rate of 1 HZ. Strobes shall be synchronized where required by the National Fire Alarm Code (NFPA 72).
  2. Backplate shall be red with 1/2 inch (13 mm) permanent red letters. Lettering to read "ALERT", be oriented on the wall or ceiling properly, and be visible from all viewing directions.
  3. Each strobe circuit shall have a minimum of 20 percent spare capacity.
  4. Strobes may be combined with the audible notification appliances specified herein.

5. Strobes shall be Simplex Model 4906-9101.

## **2.5 ALARM INITIATING DEVICES**

### **A. Manual Fire Alarm Stations:**

1. Shall be non-breakglass, address reporting type.
2. Station front shall be constructed of a durable material such as cast or extruded metal or high impact plastic. Stations shall be semi-flush type.
3. Stations shall be of single action pull down type with suitable operating instructions provided on front in raised or depressed letters, and clearly labeled "FIRE."
4. Operating handles shall be constructed of a durable material. On operation, the lever shall lock in alarm position and remain so until reset. A key shall be required to gain front access for resetting, or conducting tests and drills.
5. Unless otherwise specified, all exposed parts shall be red in color and have a smooth, hard, durable finish.
6. Stations identified as key operated only shall have a single standardized lock and key separate from the control equipment.
7. Manual Pull stations shall be Simplex Model 4099-9001.

### **B. Smoke Detectors:**

1. Smoke detectors shall be photoelectric type and UL listed for use with the fire alarm control unit being furnished.
2. Smoke detectors shall be addressable type complying with applicable UL Standards for system type detectors. Smoke detectors shall be installed in accordance with the manufacturer's recommendations and NFPA 72.
3. Detectors shall have an indication lamp to denote an alarm condition. Provide remote indicator lamps and identification plates where detectors are concealed from view. Locate the remote indicator lamps and identification plates flush mounted on walls so they can be observed from a normal standing position.
4. All spot type and duct type detectors installed shall be of the photoelectric type.
5. Photoelectric detectors shall be factory calibrated and readily field adjustable. The sensitivity of any photoelectric detector shall be factory set at 3.0 plus or minus 0.25 percent obscuration per foot.
6. Detectors shall provide a visual trouble indication if they drift out of sensitivity range or fail internal diagnostics. Detectors shall also provide visual indication of sensitivity level upon testing. Detectors, along with the fire alarm control units shall be UL listed for testing the sensitivity of the detectors.
7. Smoke detectors shall be Simplex Model 4098-9714.

### **C. Heat Detectors:**

1. Heat detectors shall be of the addressable restorable rate compensated fixed-temperature spot type.
  2. Detectors shall have a minimum smooth ceiling rating of 2,500 square feet (230 square meters).
  3. Ordinary temperature (135 degrees F (57 degrees C)) heat detectors shall be utilized in elevator shafts and elevator mechanical rooms. Intermediate temperature rated (200 degrees F (93 degrees C)) heat detectors shall be utilized in all other areas.
  4. Provide a remote indicator lamp, key test station and identification nameplate (e.g. "Heat Detector - Elevator 1) for each elevator group. Locate key test station in plain view on elevator machine room wall.
- D. Water Flow and Pressure Switches:
1. Wet pipe water flow switches and dry pipe alarm pressure switches for sprinkler systems shall be connected to the fire alarm system by way of an address reporting interface device.
  2. All new water flow switches shall be of a single manufacturer and series and non-accumulative retard type.
  3. All new switches shall have an alarm transmission delay time that is conveniently adjustable from 0 to 60 seconds. Initial settings shall be 30-45 seconds. Timing shall be recorded and documented during testing.
- E. Extinguishing System Connections:
1. Kitchen Range Hood and Duct Suppression Systems:
    - a. Each suppression system shall be equipped with a micro-switch connected to the building fire alarm control unit. Discharge of a suppression system shall automatically send an alarm signal to the building fire detection and alarm system for annunciation.
    - b. Operation of this suppression system shall also automatically shut off all sources of fuel and heat to all equipment requiring protection under the same hood.
  2. Each gaseous suppression system shall be monitored for system alarm and system trouble conditions via addressable interface devices.

## **2.6 SUPERVISORY DEVICES**

- A. Duct Smoke Detectors:
1. Duct smoke detectors shall be provided and connected by way of an address reporting interface device. Detectors shall be provided with an approved duct housing mounted exterior to the duct, and shall have perforated sampling tubes extending across the full width of the duct (wall to wall). Detector placement shall be such that there is uniform airflow in the cross section of the duct.
  2. Interlocking with fans shall be provided in accordance with NFPA 90A and as specified hereinafter under Part 3.2, "TYPICAL OPERATION".



3. Provide remote indicator lamps, key test stations and identification nameplates (e.g. "DUCT SMOKE DETECTOR AHU-X") for all duct detectors. Locate key test stations in plain view on walls or ceilings so that they can be observed and operated from a normal standing position.
4. Duct detectors shall be Simplex Model 4098-9756.
- B. Sprinkler and Standpipe System Supervisory Switches:
  1. Each sprinkler system water supply control valve, riser valve or zone control valve, and each standpipe system riser control valve shall be equipped with a supervisory switch. Standpipe hose valves, and test and drain valves shall not be equipped with supervisory switches.
  2. PIV (post indicator valve) or main gate valve shall be equipped with a supervisory switch.
  3. Valve supervisory switches shall be connected to the fire alarm system by way of address reporting interface device.
  4. The mechanism shall be contained in a weatherproof die-cast aluminum housing that shall provide a 3/4 inch (19 mm) tapped conduit entrance and incorporate the necessary facilities for attachment to the valves.
  5. The entire installed assembly shall be tamper-proof and arranged to cause a switch operation if the housing cover is removed or if the unit is removed from its mounting.
  6. Monitoring modules shall be Simplex Model 4090-9001.

## **2.7 ADDRESS REPORTING INTERFACE DEVICE**

- A. Shall have unique addresses that reports directly to the building fire alarm panel.
- B. Shall be configurable to monitor normally open or normally closed devices for both alarm and trouble conditions.
- C. Shall have terminal designations clearly differentiating between the circuit to which they are reporting from and the device that they are monitoring.
- D. Shall be UL listed for fire alarm use and compatibility with the panel to which they are connected.
- E. Shall be mounted in weatherproof housings if mounted exterior to a building.
- F. Monitoring modules shall be Simplex Model 4090-9001.

## **2.8 SMOKE BARRIER DOOR CONTROL**

- A. Electromagnetic Door Holders:
  1. New Door Holders shall be standard wall mounted electromagnetic type. In locations where doors do not come in contact with the wall when in the full open position, an extension post shall be added to the door bracket.
  2. Operation shall be by 24 volt DC supplied from a battery located at the fire alarm control unit. Door holders shall be coordinated as to voltage, ampere drain, and voltage drop with the battery, battery charger, wiring and fire alarm system for operation as specified.
- B. A maximum of twelve door holders shall be provided for each circuit. Door holders shall be wired to allow releasing doors by smoke zone.
- C. Door holder control circuits shall be electrically supervised.

- D. Smoke detectors shall not be incorporated as an integral part of door holders.
- E. Shall be Simplex Model 2088-9608.

## **2.9 UTILITY LOCKS AND KEYS:**

- A. All key operated test switches, control units, annunciator panels and lockable cabinets shall be provided with a single standardized utility lock and key.
- B. Key-operated manual fire alarm stations shall have a single standardized lock and key separate from the control equipment.
- C. All keys shall be delivered to the COR.

## **2.10 SPARE AND REPLACEMENT PARTS**

- A. Provide spare and replacement parts as follows:
  - 1. Manual pull stations - 1
  - 2. Fire alarm strobes – 3 (75cd)
  - 3. Fire alarm speakers - 3
  - 4. Smoke detectors - 2
  - 5. Duct smoke detectors with all appurtenances - 1
  - 6. 2.5 oz. containers aerosol smoke - 2
  - 7. Monitor modules - 1
  - 8. Control modules - 1
  - 9. Fire alarm SLC cable (same as installed) – 500 feet (152 m)
- B. Spare and replacement parts shall be in original packaging and submitted to the COR. **Spare and replacement parts are to be bid as furnished and installed with 50' of 0.75" conduit per device. Locations to be selected by COR/Engineer in field.**
- C. Furnish and install a storage cabinet of sufficient size and suitable for storing spare equipment. Doors shall include a pad locking device. Padlock to be provided by the VA. Location of cabinet to be determined by the COR.
- D. Provide to the VA, all hardware, software, programming tools, license and documentation necessary to permanently modify the fire alarm system on site. The minimum level of modification includes addition and deletion of devices, circuits, zones and changes to system description, system operation, and digitized evacuation and instructional messages.

## **2.11 INSTRUCTION CHART:**

- A. Provide typewritten instruction card mounted behind a Lexan plastic or glass cover in a stainless steel or aluminum frame with a backplate. Install the frame in a conspicuous location observable from each control unit where operations are performed. The card shall show those steps to be taken by an operator when a signal is received under all conditions, normal, alarm, supervisory, and trouble. Provide an additional copy with the binder for the input output matrix for the sequence of operation. The instructions shall be approved by the COR before being posted.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION:**

- A. Installation shall be in accordance with NFPA 70, 72, 90A, and 101 as shown on the drawings, and as recommended by the major equipment manufacturer. Fire alarm wiring shall be installed in conduit. All conduit and wire shall be installed in accordance with Section 26 05 33 RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS, and all penetrations of smoke and fire barriers shall be protected as required by Section 07 84 00, FIRESTOPPING.
- B. All conduits, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas.
- C. All new and reused exposed conduits shall be painted in accordance with Section 09 91 00, PAINTING to match surrounding finished areas and red in unfinished areas.
- D. All existing accessible fire alarm conduit not reused shall be removed.
- E. Existing devices that are reused shall be properly mounted and installed. Where devices are installed on existing shallow backboxes, extension rings of the same material, color and texture of the new fire alarm devices shall be used. Mounting surfaces shall be cut and patched in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Restoration, and be re-painted in accordance with Section 09 91 00, PAINTING as necessary to match existing.
- F. All fire detection and alarm system devices, control units and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas. Exact locations are to be approved by the COR.
- G. Strobes shall be flush wall mounted with the bottom of the unit located 80 inches (2,000 mm) above the floor or 6 inches (150 mm) below ceiling, whichever is lower. Locate and mount to maintain a minimum 36 inches (900 mm) clearance from side obstructions.
- H. Manual pull stations shall be installed not less than 42 inches (1,050 mm) or more than 48 inches (1,200 mm) from finished floor to bottom of device and within 60 inches (1,500 mm) of a stairway or an exit door.
- I. Where possible, locate water flow and pressure switches a minimum of 12 inches (300 mm) from a fitting that changes the direction of the flow and a minimum of 36 inches (900 mm) from a valve.
- J. Mount valve tamper switches so as not to interfere with the normal operation of the valve and adjust to operate within 2 revolutions toward the closed position of the valve control, or when the stem has moved no more than 1/5 of the distance from its normal position.

### **3.2 TYPICAL OPERATION**

- A. Activation of any manual pull station, water flow or pressure switch, heat detector, kitchen hood suppression system, gaseous suppression system, or smoke detector shall cause the following operations to occur:
  - 1. Continuously sound a temporal pattern general alarm and flash all strobes in the building in alarm until reset at the local fire alarm control unit in Buildings 31.

2. Release only the magnetic door holders on the floor from which alarm was initiated after the alert signal.
  3. Transmit a separate alarm signal, via the main fire alarm control unit to the fire department.
  4. Unlock the electrically locked exit doors within the zone of alarm.
- B. Heat detectors in elevator machine rooms shall, in addition to the above functions, disconnect all power to all elevators served by that machine room after a time delay. The time delay shall be programmed within the fire alarm system programming and be equal to the time it takes for the car to travel from the highest to the lowest level, plus 10 seconds.
- C. Smoke detectors in the primary elevator lobbies of Building 31 shall, in addition to the above functions, return all elevators in the bank to the secondary floor.
- D. Smoke detectors in the remaining elevator lobbies, elevator machine room, or top of hoistway shall, in addition to the above functions, return all elevators in the bank to the primary floor.
- E. Operation of a smoke detector at a corridor door used for automatic closing shall also release only the magnetic door holders on that floor.
- F. Operation of duct smoke detectors shall cause a system supervisory condition and shut down the ventilation system and close the associated smoke dampers as appropriate.
- G. Operation of any sprinkler or standpipe system valve supervisory switch, high/low air pressure switch, or fire pump alarm switch shall cause a system supervisory condition.
- H. Alarm verification shall not be used for smoke detectors installed for the purpose of early warning.

### **3.3 TESTS**

- A. Provide the service of a NICET level III, competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system. Make all adjustments and tests in the presence of the COR.
- B. When the systems have been completed and prior to the scheduling of the final inspection, furnish testing equipment and perform the following tests in the presence of the COR. When any defects are detected, make repairs or install replacement components, and repeat the tests until such time that the complete fire alarm systems meets all contract requirements. After the system has passed the initial test and been approved by the COR, the contractor may request a final inspection.
1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
  2. Test the insulation on all installed cable and wiring by standard methods as recommended by the equipment manufacturer.
  3. Run water through all flow switches. Check time delay on water flow switches. Submit a report listing all water flow switch operations and their retard time in seconds.
  4. Open each alarm initiating and notification circuit to see if trouble signal actuates.

5. Ground each alarm initiation and notification circuit and verify response of trouble signals.

### **3.4 FINAL INSPECTION AND ACCEPTANCE**

- A. Prior to final acceptance a minimum 30 day "burn-in" period shall be provided. The purpose shall be to allow equipment to stabilize and potential installation and software problems and equipment malfunctions to be identified and corrected. During this diagnostic period, all system operations and malfunctions shall be recorded. Final acceptance will be made upon successful completion of the "burn-in" period and where the last 14 days is without a system or equipment malfunction.
- B. At the final inspection a factory trained representative of the manufacturer of the major equipment shall repeat the tests in Article 3.3 TESTS and those required by NFPA 72. In addition the representative shall demonstrate that the systems function properly in every respect. The demonstration shall be made in the presence of a VA representative.

### **3.5 INSTRUCTION**

- A. The manufacturer's authorized representative shall provide instruction and training to the VA as follows:
  1. Two 1-hour sessions to engineering staff, security police and central attendant personnel for simple operation of the system. One session at the start of installation and one session at the completion of installation.
  2. One 2-hour session to engineering staff for detailed operation of the system at the completion of installation.
- B. The Contractor and/or the Systems Manufacturer's representative shall provide a typewritten "Sequence of Operation" including a trouble shooting guide of the entire system for submittal to the VA. The sequence of operation will be shown for each input in the system in a matrix format and provided in a loose leaf binder. When reading the sequence of operation, the reader will be able to quickly and easily determine what output will occur upon activation of any input in the system. The INPUT/OUTPUT matrix format shall be as shown in Appendix A to NFPA 72.
- C. Furnish the services of a competent instructor for instructing personnel in the programming requirements necessary for system expansion. Such programming shall include addition or deletion of devices, zones, indicating circuits and printer/display text.

- - END - -

**SECTION 31 20 00  
EARTHWORK**

**PART 1 - GENERAL**

**1.1 DESCRIPTION OF WORK:**

- A. This section specifies the requirements for furnishing all equipment, materials, labor, tools, and techniques for earthwork including, but not limited to, the following:
1. Site preparation.
  2. Excavation.
  3. Not Used
  4. Filling and backfilling.
  5. Grading.
  6. Soil Disposal.
  7. Clean Up.

**1.2 DEFINITIONS:**

- A. Unsuitable Materials:
1. Fills: Topsoil; frozen materials; construction materials and materials subject to decomposition; clods of clay and stones larger than 75 mm (3 inches); organic material, including silts, which are unstable; and inorganic materials, including silts, too wet to be stable and any material with a liquid limit and plasticity index exceeding 40 and 15 respectively. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction, as defined by ASTM D698.
  2. Existing Subgrade (Except Footing Subgrade): Same materials as 1.2.A.1, that are not capable of direct support of slabs, pavement, and similar items with possible exception of improvement by compaction, proofrolling, or similar methods.
  3. Existing Subgrade (Footings Only): Same as paragraph 1, but no fill or backfill. If materials differ from design requirements, excavate to acceptable strata subject to Resident Engineer's approval.
- B. Building Earthwork: Earthwork operations required in area enclosed by a line located 1500 mm (5 feet) outside of principal building perimeter. It also includes earthwork required for auxiliary structures and buildings.
- C. Trench Earthwork: Trenchwork required for utility lines.
- D. Site Earthwork: Earthwork operations required in area outside of a line located 1500 mm (5 feet) outside of principal building perimeter and within new construction area with exceptions noted above.
- E. Degree of compaction: Degree of compaction is expressed as a percentage of maximum density obtained by laboratory test procedure. This percentage of maximum density is obtained through

use of data provided from results of field test procedures presented in ASTM D1556, ASTM D2167, and ASTM D6938.

- F. Fill: Satisfactory soil materials used to raise existing grades. In the Construction Documents, the term "fill" means fill or backfill as appropriate.
- G. Backfill: Soil materials or controlled low strength material used to fill an excavation.
- H. Unauthorized excavation: Removal of materials beyond indicated sub-grade elevations or indicated lines and dimensions without written authorization by the Resident Engineer. No payment will be made for unauthorized excavation or remedial work required to correct unauthorized excavation.
- I. Authorized additional excavation: Removal of additional material authorized by the Resident Engineer based on the determination by the Government's soils testing agency that unsuitable bearing materials are encountered at required sub-grade elevations. Removal of unsuitable material and its replacement as directed will be paid on basis of Conditions of the Contract relative to changes in work.
- J. Subgrade: The undisturbed earth or the compacted soil layer immediately below granular sub-base, drainage fill, or topsoil materials.
- K. Structure: Buildings, foundations, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- L. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.
- M. Drainage course: Layer supporting slab-on-grade used to minimize capillary flow of pore water.
- N. Bedding course: Layer placed over the excavated sub-grade in a trench before laying pipe. Bedding course shall extend up to the springline of the pipe.
- O. Sub-base Course: Layer placed between the sub-grade and base course for asphalt paving or layer placed between the sub-grade and a concrete pavement or walk.
- P. Utilities include on-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.
- Q. Debris: Debris includes all materials located within the designated work area not covered in the other definitions and shall include but not be limited to items like vehicles, equipment, appliances, building materials or remains thereof, tires, any solid or liquid chemicals or products stored or found in containers or spilled on the ground.
- R. Contaminated soils: Soil that contains contaminants as defined and determined by the Resident Engineer or the Government's testing agency.

### **1.3 RELATED WORK:**

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Not Used.

- C. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements:  
Section 01 00 00, GENERAL REQUIREMENTS.
- D. Subsurface Investigation: Section 01 00 00, GENERAL REQUIREMENTS, Article, PHYSICAL  
DATA.
- E. Erosion Control: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS
- F. Site preparation: Section 31 23 19, DEWATERING,
- H. Paving sub-grade requirements: Section 32 12 16, ASPHALT PAVING.

#### **1.4 CLASSIFICATION OF EXCAVATION:**

- A. Unclassified Excavation: Removal and disposal of pavements and other man-made obstructions  
visible on surface; utilities, and other items including underground structures indicated to be  
demolished and removed; together with any type of materials regardless of character of material  
and obstructions encountered.

#### **1.5 NOT USED**

#### **1.6 NOT USED**

#### **1.7 NOT USED**

#### **1.8 APPLICABLE PUBLICATIONS:**

- A. Publications listed below form a part of this specification to extent referenced. Publications are  
referenced in text by basic designation only.
- B. American Association of State Highway and Transportation Officials (AASHTO):
  - T99-10 ..... Standard Method of Test for Moisture-Density Relations of Soils  
Using a 2.5 kg (5.5 lb) Rammer and a 305 mm (12 inch) Drop
  - T180-10 ..... Standard Method of Test for Moisture-Density Relations of Soils  
using a 4.54 kg (10 lb) Rammer and a 457 mm (18 inch) Drop
- C. American Society for Testing and Materials (ASTM):
  - C33-03 ..... Concrete Aggregate
  - D448-08 ..... Standard Classification for Sizes of Aggregate for Road and  
Bridge Construction
  - D698-07e1 ..... Standard Test Method for Laboratory Compaction  
Characteristics of Soil Using Standard Effort (12,400 ft. lbf/ft<sup>3</sup>  
(600 kN m/m<sup>3</sup>))
  - D1140-00 ..... Amount of Material in Soils Finer than the No. 200 (75-  
micrometer) Sieve
  - D1556-07 ..... Standard Test Method for Density and Unit Weight of Soil in  
Place by the Sand Cone Method



- D1557-09 ..... Standard Test Methods for Laboratory Compaction  
Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup>  
(2700 kN m/m<sup>3</sup>))
- D2167-08 ..... Standard Test Method for Density and Unit Weight of Soil in  
Place by the Rubber Balloon Method
- D2487-11 ..... Standard Classification of Soils for Engineering Purposes  
(Unified Soil Classification System)
- D2940-09 ..... Standard Specifications for Graded Aggregate Material for Bases  
or Subbases for Highways or Airports
- D6938-10 ..... Standard Test Method for In-Place Density and Water Content of  
Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
- D. Society of Automotive Engineers (SAE):
- J732-07 ..... Specification Definitions - Loaders
- J1179-08 ..... Hydraulic Excavator and Backhoe Digging Forces

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS:**

- A. General: Provide borrow soil material when sufficient satisfactory soil materials are not available from excavations.
- B. Fills: Material in compliance with ASTM D2487 Soil Classification Groups GW, GP, GM, SW, SP, SM, SC, and ML, or any combination of these groups; free of rock or gravel larger than 75 mm (3 inches) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter. Material approved from on site or off site sources having a minimum dry density of 1760 kg/m<sup>3</sup> (110 pcf), a maximum Plasticity Index of 15, and a maximum Liquid Limit of 40.
- C. Engineered Fill: Naturally or artificially graded mixture of compliance with ASTM D2487 Soil Classification Groups GW, GP, GM, SW, SP, SM, SC, and ML, or any combination of these groups, or as approved by the Engineer or material with at least 90 percent passing a 37.5-mm (1 1/2-inch) sieve and not more than 12 percent passing a 75-µm (No. 200) sieve, per ASTM D2940;.
- D. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; except with 100 percent passing a 25 mm (1 inch) sieve and not more than 8 percent passing a 75-µm (No. 200) sieve.
- E. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D448; coarse-aggregate grading Size 57; with 100 percent passing a 37.5 mm (1 1/2-inch) sieve and 0 to 5 percent passing a 2.36 mm (No. 8) sieve.
- F. Granular Fill:
1. Under concrete slab, - granular fill shall consist of clean, poorly graded crushed rock, crushed gravel, or uncrushed gravel placed beneath a building slab with or without a vapor barrier to

- cut off the capillary flow of pore water to the area immediately below. Aggregate grading shall be crushed stone or gravel graded from 25 mm (1 inch) to 4.75 mm (No. 4), per ASTM D 2940.
2. Bedding for sanitary and storm sewer pipe, crushed stone or gravel graded from 13 mm (1/2 inch) to 4.75 mm (No 4), per ASTM D2940.
- G. Requirements for Offsite Soils: Offsite soils brought in for use as backfill shall be tested for TPH, BTEX and full TCLP including ignitability, corrosivity and reactivity. Backfill shall contain less than 100 parts per million (ppm) of total hydrocarbons (TPH) and less than 10 ppm of the sum of Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and shall not fail the TCLP test. TPH concentrations shall be determined by using EPA 600/4-79/020 Method 418.1. BTEX concentrations shall be determined by using EPA SW-846.3-3a Method 5030/8020. TCLP shall be performed in accordance with EPA SW-846.3-3a Method 1311. Provide Borrow Site Testing for TPH, BTEX and TCLP from a composite sample of material from the borrow site, with at least one test from each borrow site.
- H. Buried Warning and Identification Tape: metallic core or metallic-faced, acid- and alkali-resistant polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inch minimum width, color coded as specific below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, Unaffected by moisture or soil.
- I. Warning Tape for Metallic Piping: Acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of tape shall be 0.076 mm (0.003 inch). Tape shall have a minimum strength of 10.3 MPa (1500 psi) lengthwise, and 8.6 MPa (1250 psi) crosswise, with a maximum 350 percent elongation.
- J. Detectable Warning Tape for Non-Metallic Piping: Polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.102 mm (0.004 inch). Tape shall have a minimum strength of 10.3 MPa (1500 psi) lengthwise and 8.6 MPa (1250 psi) crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 0.9 m (3 feet) deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.
- K. Detection Wire For Non-Metallic Piping: Detection wire shall be Insulated single strand, solid copper with a minimum of 12 AWG.

### **PART 3 - EXECUTION**

#### **3.1 SITE PREPARATION:**

- A. Clearing: Clear within limits of earthwork operations as shown. Work includes removal of trees, shrubs, fences, foundations, incidental structures, paving, debris, trash, and other obstructions. Remove materials from Medical Center.
- B. Grubbing: Remove stumps and roots 75 mm (3 inch) and larger diameter. Undisturbed sound stumps, roots up to 75 mm (3 inch) diameter, and nonperishable solid objects a minimum of 900 mm (3 feet) below subgrade or finished embankment may be left.
- C. Trees and Shrubs: Trees and shrubs, not shown for removal, may be removed from areas within 4500 mm (15 feet) of new construction and 2250 mm (7.5 feet) of utility lines when removal is approved in advance by Resident Engineer. Remove materials from Medical Center. Box, and otherwise protect from damage, existing trees and shrubs which are not shown to be removed in construction area. Immediately repair damage to existing trees and shrubs by trimming, cleaning and painting damaged areas, including roots, in accordance with standard industry horticultural practice for the geographic area and plant species. Do not store building materials closer to trees and shrubs, that are to remain, than farthest extension of their limbs.
- D. Stripping Topsoil: Strip topsoil from within limits of earthwork operations as specified. Topsoil shall be a fertile, friable, natural topsoil of loamy character and characteristic of locality. Topsoil shall be capable of growing healthy horticultural crops of grasses. Stockpile topsoil and protect as directed by Resident Engineer. Eliminate foreign materials, such as weeds, roots, stones, subsoil, frozen clods, and similar foreign materials larger than 0.014 m<sup>3</sup> (1/2 cubic foot) in volume, from soil as it is stockpiled. Retain topsoil on station. Remove foreign materials larger than 50 mm (2 inches) in any dimension from topsoil used in final grading. Topsoil work, such as stripping, stockpiling, and similar topsoil work shall not, under any circumstances, be carried out when soil is wet so that the composition of the soil will be destroyed.
- E. Concrete Slabs and Paving: Score deeply or saw cut to insure a neat, straight cut, sections of existing concrete slabs and paving to be removed where excavation or trenching occurs. Extend pavement section to be removed a minimum of 300 mm (12 inches) on each side of widest part of trench excavation and insure final score lines are approximately parallel unless otherwise indicated. Remove material from Medical Center.
- F. Lines and Grades:
  - 1. Grades shall conform to elevations indicated on plans within the tolerances herein specified. Generally grades shall be established to provide a smooth surface, free from irregular surface changes. Grading shall comply with compaction requirements and grade cross sections, lines, and elevations indicated. Where spot grades are indicated the grade shall be established based on interpolation of the elevations between the spot grades while

- maintaining appropriate transition at structures and paving and uninterrupted drainage flow into inlets.
2. Locations of existing and proposed elevations indicated on plans, except spot elevations, are approximate. Proposed spot elevations and contour lines have been developed utilizing the existing conditions survey and developed contour lines and may be approximate. Contractor is responsible to notify Resident Engineer of any differences between existing elevations shown on plans and those encountered on site. Notify Resident Engineer of any differences between existing or constructed grades, as compared to those shown on the plans.
  3. Subsequent to establishment of lines and grades, Contractor will be responsible for any additional cut and/or fill required to ensure that site is graded to conform to elevations indicated on plans.
  4. Finish grading is specified in Section 32 90 00, PLANTING.
- G. Disposal: All materials removed from the property shall be disposed of at a legally approved site, for the specific materials, and all removals shall be in accordance with all applicable Federal, State and local regulations.

### **3.2 EXCAVATION:**

- A. Shoring, Sheet piling and Bracing: Shore, brace, or slope, its angle of repose or to an angle considered acceptable by the Resident Engineer, banks of excavations to protect workmen, banks, adjacent paving, structures, and utilities.
1. Design of the temporary support of excavation system is the responsibility of the Contractor. The Contractor shall submit a Shoring and Sheet piling plan for approval 15 days prior to starting work. Submit drawings and calculations, certified by a registered professional engineer, describing the methods for shoring and sheet piling of excavations. Shoring, including sheet piling, shall be furnished and installed as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Shoring, bracing, and sheet piling shall be removed as excavations are backfilled, in a manner to prevent caving.
  2. Construction of the support of excavation system shall not interfere with the permanent structure and may begin only after a review by the Resident Engineer.
  3. Extend shoring and bracing to a minimum of 1500 mm (5 feet) below the bottom of excavation. Shore excavations that are carried below elevations of adjacent existing foundations.
  4. If bearing material of any foundation is disturbed by excavating, improper shoring or removal of existing or temporary shoring, placing of backfill, and similar operations, the Contractor shall provide a concrete fill support under disturbed foundations, as directed by Resident Engineer, at no additional cost to the Government. Do not remove shoring until permanent work in excavation has been inspected and approved by Resident Engineer.

- B. Excavation Drainage: Operate pumping equipment, and/or provide other materials, means and equipment as required to keep excavation free of water and subgrade dry, firm, and undisturbed until approval of permanent work has been received from Resident Engineer. Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 0.9 m (3 feet) of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. Operate dewatering system continuously until construction work below existing water levels is complete.
- C. Subgrade Protection: Protect subgrades from softening, undermining, washout, or damage by rain or water accumulation. Reroute surface water runoff from excavated areas and not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches. When subgrade for foundations has been disturbed by water, remove disturbed material to firm undisturbed material after water is brought under control. Replace disturbed subgrade in trenches with concrete or material approved by the Resident Engineer.
- E. Proofrolling:
  - 1. After rough grade has been established in cut areas and prior to placement of fill in fill areas under building and pavements, proofroll exposed subgrade with a fully loaded dump truck to check for pockets of soft material.
  - 2. Proof rolling shall be done on an exposed subgrade free of surface water (wet conditions resulting from rainfall) which would promote degradation of an otherwise acceptable subgrade. After stripping, proof roll the existing subgrade with six passes of a dump truck loaded with 6 cubic meters (4 cubic yards) of soil. Operate the truck in a systematic manner to ensure the number of passes over all areas, and at speeds between 4 to 5.5 km/hour (2 1/2 to 3 1/2 mph). When proof rolling, one-half of the passes made with the roller shall be in a direction perpendicular to the other passes. Notify the Resident Engineer a minimum of 3 days prior to proof rolling. Proof rolling shall be performed in the presence of the Resident Engineer. Rutting or pumping of material shall be undercut as directed by the Resident Engineer to a depth of 18 (inches) and replaced with select material. Bids shall be based on replacing approximately 100 square yards). Maintain subgrade until succeeding operation has been accomplished.
- F. Building Earthwork:
  - 1. Excavation shall be accomplished as required by drawings and specifications.
  - 2. Excavate foundation excavations to solid undisturbed subgrade.
  - 3. Remove loose or soft materials to a solid bottom.

4. Fill excess cut under footings or foundations with 25 MPa (3000 psi) concrete poured separately from the footings.
  5. Do not tamp earth for backfilling in footing bottoms, except as specified.
  6. Slope grades to direct water away from excavations and to prevent ponding.
  7. Capillary water barrier (granular fill) under concrete floor and area-way slabs on grade shall be placed directly on the subgrade and shall be compacted with a minimum of two passes of a hand-operated plate-type vibratory compactor.
  8. Ensure that footing subgrades have been inspected and approved by the Resident Engineer prior to concrete placement. Excavate to bottom of pile cap prior to placing or driving piles, unless authorized otherwise by the Resident Engineer. Backfill and compact over excavations and changes in grade due to pile driving operations to 95 percent of ASTM D698 maximum density.
- G. Trench Earthwork:
1. Utility trenches (except sanitary and storm sewer):
    - a. Excavate to a width as necessary for sheeting and bracing and proper performance of the work.
    - b. Grade bottom of trenches with bell holes scooped out to provide a uniform bearing.
    - c. Support piping on suitable undisturbed earth unless a mechanical support is shown. Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 150 mm (6 inches) loose thickness.
    - d. Length of open trench in advance of piping laying shall not be greater than is authorized by Resident Engineer.
    - e. Provide buried utility lines with utility identification tape. Bury tape 300 mm (12 inches) below finished grade; under pavements and slabs, bury tape 150 mm (6 inches) below top of subgrade
    - f. Bury detection wire directly above non-metallic piping at a distance not to exceed 300 mm (12 inches) above the top of pipe. The wire shall extend continuously and unbroken, from manhole to manhole. The ends of the wire shall terminate inside the manholes at each end of the pipe, with a minimum of 0.9 m (3 feet) of wire, coiled, remaining accessible in each manhole. The wire shall remain insulated over its entire length. The wire shall enter manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, the wire shall terminate in the valve pit at the pump station end of the pipe.
    - g. Bedding shall be of the type and thickness shown. Initial backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the

full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe. Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Backfill to top of pipe shall be compacted to 95 percent of ASTM D 698 maximum density. Plastic piping shall have bedding to spring line of pipe. Provide materials as follows:

- 1) Clean, coarse-grained sand
2. Sanitary and storm sewer trenches:
  - a. Trench width below a point 150 mm (6 inches) above top of pipe shall be 600 mm (24 inches) maximum for pipe up to and including 300 mm (12 inches) diameter, and four-thirds diameter of pipe plus 200 mm (8 inches) for pipe larger than 300 mm (12 inches). Width of trench above that level shall be as necessary for sheeting and bracing and proper performance of the work.
    - 1) Bed bottom quadrant of pipe on suitable undisturbed soil or granular fill. Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 150 mm (6 inches) loose thickness. 1) Undisturbed: Bell holes shall be no larger than necessary for jointing. Backfill up to a point 300 mm (12 inches) above top of pipe shall be clean earth placed and tamped by hand.
    - 2) Granular Fill: Depth of fill shall be a minimum of 75 mm (3 inches) plus one sixth of pipe diameter below pipe to 300 mm (12 inches) above top of pipe. Place and tamp fill material by hand.
  - c. Place and compact as specified remainder of backfill using acceptable excavated materials. Do not use unsuitable materials.
  - d. Use granular fill for bedding where rock or rocky materials are excavated.
  - e. Provide buried utility lines with utility identification tape. Bury tape 300 mm (12 inches) below finished grade; under pavements and slabs, bury tape 150 mm (6 inches) below top of subgrade
  - f. Bury detection wire directly above non-metallic piping at a distance not to exceed 300 mm (12 inches) above the top of pipe. The wire shall extend continuously and unbroken, from manhole to manhole. The ends of the wire shall terminate inside the manholes at each end of the pipe, with a minimum of 0.9 m (3 feet) of wire, coiled, remaining accessible in each manhole. The wire shall remain insulated over its entire length. The wire shall enter manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, the wire shall terminate in the valve pit at the pump station end of the pipe.

- g. Bedding shall be of the type and thickness shown. Initial backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe. Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Backfill to top of pipe shall be compacted to 95 percent of ASTM D698 maximum density. Plastic piping shall have bedding to spring line of pipe. Provide materials as follows:
  - 1) Clean, coarse-grained sand
- H. Site Earthwork: Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation. Excavation shall be accomplished as required by drawings and specifications. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 25 mm (1 inch). Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, complying with OSHA requirements, and for inspections. Remove subgrade materials that are determined by Resident Engineer as unsuitable, and replace with acceptable material.
  - 1. Site Grading:
    - a. Provide a smooth transition between adjacent existing grades and new grades.
    - b. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
    - c. Slope grades to direct water away from buildings and to prevent ponds from forming where not designed. Finish subgrades to required elevations within the following tolerances:
      - 1) Lawn or Unpaved Areas: Plus or minus 25 mm (1 inch).
      - 2) Walks: Plus or minus 25 mm (1/2 inch).
      - 3) Pavements: Plus or minus 13 mm (1/2 inch).
    - d. Grading Inside Building Lines: Finish subgrade to a tolerance of 13 mm (1/2 inch) when tested with a 3000 mm (10 foot) straightedge.

### **3.3 NOT USED**

### **3.4 FILLING AND BACKFILLING:**

- A. General: Do not fill or backfill until all debris, water, unsatisfactory soil materials, obstructions, and deleterious materials have been removed from excavation. For fill and backfill, use excavated materials and borrow meeting the criteria specified herein, as applicable. Borrow will be supplied



at no additional cost to the Government. Do not use unsuitable excavated materials. Do not backfill until foundation walls have been completed above grade and adequately braced, waterproofing or dampproofing applied, foundation drainage, and pipes coming in contact with backfill have been installed and work inspected and approved by Resident Engineer.

- B. Placing: Place materials in horizontal layers not exceeding 200 mm (8 inches) in loose depth for material compacted by heavy compaction equipment, and not more than 100 mm (4 inches) in loose depth for material compacted by hand-operated tampers and then compacted. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure. Place no material on surfaces that are muddy, frozen, or contain frost.
- C. Compaction: Compact with approved tamping rollers, sheepfoot rollers, pneumatic tired rollers, steel wheeled rollers, vibrator compactors, or other approved equipment (hand or mechanized) well suited to soil being compacted. Do not operate mechanized vibratory compaction equipment within 3000 mm (10 feet) of new or existing building walls without prior approval of Resident Engineer. Moisten or aerate material as necessary to provide moisture content that will readily facilitate obtaining specified compaction with equipment used. Backfill adjacent to any and all types of structures shall be placed and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials to prevent wedging action or eccentric loading upon or against the structure. Compact soil to not less than the following percentages of maximum dry density, according to ASTM D698 or ASTM D1557 as specified below:
  - 1. Fills, Embankments, and Backfill
    - a. Under proposed structures, building slabs, steps, and paved areas, scarify and recompact top 300 mm (12 inches) of existing subgrade and each layer of backfill or fill material in accordance with ASTM D698.
    - b. Curbs, curbs and gutters, ASTM D698.
    - c. Under Sidewalks, scarify and recompact top 150 mm (6 inches) below subgrade and compact each layer of backfill or fill material in accordance with ASTM D698.
  - 2. Natural Ground (Cut or Existing)
    - a. Under proposed structures, building slabs, steps, and paved areas, scarify and recompact top 300 mm (12 inches) of existing subgrade and each layer of backfill or fill material in accordance with ASTM D698.
    - b. Curbs, curbs and gutters, ASTM D698.
    - c. Under Sidewalks, scarify and recompact top 150 mm (6 inches) below subgrade and compact each layer of backfill or fill material in accordance with ASTM D698.
- D. Borrow Material: Borrow material shall be selected to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Borrow material shall be obtained from the

borrow areas selected by the Contractor or from approved private sources. Unless otherwise provided in the contract, the Contractor shall obtain from the owners the right to procure material, pay royalties and other charges involved, and bear the expense of developing the sources, including rights-of-way for hauling. Borrow material from approved sources on Government-controlled land may be obtained without payment of royalties. Unless specifically provided, no borrow shall be obtained within the limits of the project site without prior written approval. Necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon shall be considered related operations to the borrow excavation.

- E. Opening and Drainage of Excavation and Borrow Pits: The Contractor shall notify the Resident Engineer sufficiently in advance of the opening of any excavation or borrow pit to permit elevations and measurements of the undisturbed ground surface to be taken. Except as otherwise permitted, borrow pits and other excavation areas shall be excavated providing adequate drainage. Overburden and other spoil material shall be transported to designated spoil areas or otherwise disposed of as directed. Borrow pits shall be neatly trimmed and drained after the excavation is completed. The Contractor shall ensure that excavation of any area, operation of borrow pits, or dumping of spoil material results in minimum detrimental effects on natural environmental conditions.

### **3.5 GRADING:**

- A. General: Uniformly grade the areas within the limits of this section, including adjacent transition areas. Smooth the finished surface within specified tolerance. Provide uniform levels or slopes between points where elevations are indicated, or between such points and existing finished grades. Provide a smooth transition between abrupt changes in slope.
- B. Cut rough or sloping rock to level beds for foundations. In pipe spaces or other unfinished areas, fill low spots and level off with coarse sand or fine gravel.
- C. Slope backfill outside building away from building walls for a minimum distance of 1800 mm (6 feet).
- D. Finish grade earth floors in pipe basements as shown to a level, uniform slope and leave clean.
- E. Finished grade shall be at least 150 mm (6 inches) below bottom line of window or other building wall openings unless greater depth is shown.
- F. Place crushed stone or gravel fill under concrete slabs on grade, tamped, and leveled. Thickness of fill shall be 150 mm (6 inches) unless otherwise shown.
- G. Finish subgrade in a condition acceptable to Resident Engineer at least one day in advance of paving operations. Maintain finished subgrade in a smooth and compacted condition until succeeding operation has been accomplished. Scarify, compact, and grade subgrade prior to further construction when approved compacted subgrade is disturbed by Contractor's subsequent operations or adverse weather.

- H. Grading for Paved Areas: Provide final grades for both subgrade and base course to +/- 6 mm (0.25 inches) of indicated grades.

**3.6 DISPOSAL OF UNSUITABLE AND EXCESS EXCAVATED MATERIAL:**

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Medical Center property.
- B. Remove from site and dispose of any excess excavated materials after all fill and backfill operations have been completed.
- C. Segregate all excavated contaminated soil designated by the Resident Engineer from all other excavated soils, and stockpile on site on two 0.15 mm (6 mil) polyethylene sheets with a polyethylene cover. A designated area shall be selected for this purpose. Dispose of excavated contaminated material in accordance with State and Local requirements.

**3.7 CLEAN UP:**

Upon completion of earthwork operations, clean areas within contract limits, remove tools, and equipment. Provide site clear, clean, free of debris, and suitable for subsequent construction operations. Remove all debris, rubbish, and excess material from Medical Center Property.

----- E N D -----

**SECTION 32 05 23**  
**CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Subbase for concrete pavements.
  - 2. Pedestrian Pavement: Walks.
  - 3. Equipment Pads.

**1.2 RELATED REQUIREMENTS**

- A. Field Testing: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Subgrade Preparation and Subbase Compaction: Section 31 20 00, EARTHWORK.

**1.3 APPLICABLE PUBLICATIONS**

- A. Comply with references to extent specified in this section.
- B. American Association of State Highway and Transportation Officials (AASHTO):
  - 1. M147-65-UL-04 - Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses.
  - 2. M233-86 - Boiled Linseed Oil Mixture for Treatment of Portland Cement Concrete.
- C. American Concrete Institute (ACI):
  - 1. 305R-10 - Guide to Hot Weather Concreting.
  - 2. 306R-10 - Guide to Cold Weather Concreting.
- D. American National Standards Institute (ANSI):
  - 1. B101.3 - Wet DOCF of Common Hard Surface Floor Materials (Including Action and Limit Thresholds for the Suitable Assessment of the Measured Values).
- E. ASTM International (ASTM):
  - 1. A615/A615M-16 - Deformed and Plain Carbon Steel Bars for Concrete Reinforcement.
  - 2. A996/A996M-15 - Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.
  - 3. A1064/A1064M-16 - Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
  - 4. C33/C33M-16 - Concrete Aggregates.
  - 5. C94/C94M-16 - Ready Mixed Concrete.
  - 6. C143/C143M-15a - Slump of Hydraulic Cement Concrete.
  - 7. C150/C150M-16 - Portland Cement.
  - 8. C171-16 - Sheet Materials for Curing Concrete.
  - 9. C260/C260M-10a - Air Entraining Admixtures for Concrete.
  - 10. C309-11 - Liquid Membrane Forming Compounds for Curing Concrete.

11. C494/C494M-15a - Chemical Admixtures for Concrete.
12. C618-15 - Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
13. C979/C979M-16 - Pigments for Integrally Colored Concrete.
14. C989/C989M-14 - Slag Cement for Use in Concrete and Mortars.
15. C1240-15 - Silica Fume Used in Cementitious Mixtures.
16. D1751-04(2013)e1 - Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
17. D5893/D5893M-10 - Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements.
18. D6690-15 - Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.

**1.4 Not used**

**1.5 SUBMITTALS**

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submittal Drawings:
  1. Show size, configuration, and fabrication and installation details.
  2. Show reinforcing.
  3. Include jointing plan for concrete pavements, curbs and gutters.
- C. Manufacturer's Literature and Data:
  1. Description of each product.
  2. Installation instructions.
- D. Not Used
- E. Test reports: Certify products comply with specifications.
  1. Concrete materials.
  2. Select subbase materials.
  3. Field test reports.
- F. Certificates: Certify products comply with specifications.
  1. Expansion joint filler.
  2. Reinforcement.
  3. Curing materials.
  4. Concrete protective coating.
- G. Not Used
- H. Concrete mix design.
- I. Select subbase job-mix design.
- J. Proposed hot and cold weather concreting methods.

## **1.6 QUALITY ASSURANCE**

- A. Installer Qualifications:
  - 1. Regularly installs specified products.
  - 2. Installed specified products with satisfactory service on five similar installations.
- B. Preconstruction Testing:
  - 1. Engage independent testing laboratory to perform tests and submit reports.
    - a. Deliver samples to laboratory in number and quantity required for testing.
  - 2. Concrete mix design.
  - 3. Select subbase job-mix design. Report the following:
    - a. Material sources.
    - b. Gradation.
    - c. Plasticity index.
    - d. Liquid limit.
    - e. Laboratory compaction curves indicating maximum density at optimum moisture content.

## **1.7 DELIVERY**

- A. Deliver steel reinforcement to prevent damage.
- B. Before installation, return or dispose of distorted or damaged steel reinforcement.
- C. Bulk Products: Deliver bulk products away from buildings, utilities, pavement, and existing turf and planted areas. Maintain dry bulk product storage away from contaminants.

## **1.8 STORAGE AND HANDLING**

- A. Store products indoors in dry, weathertight facility.
- B. Protect products from damage during handling and construction operations.

## **1.9 FIELD CONDITIONS**

- A. Hot Weather Concreting Procedures: ACI 305R.
- B. Cold Weather Concreting Procedures: ACI 306R.
  - 1. Use non-corrosive, non-chloride accelerator admixture.
  - 2. Do not use calcium chloride, thiocyanates or admixtures containing more than 0.05 percent chloride ions.

## **1.10 WARRANTY**

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

# **PART 2 - PRODUCTS**

## **2.1 CONCRETE MATERIALS**

- A. Portland Cement: ASTM C150/C150M, Type I or II.

- B. Pozzolans:
  - 1. Fly Ash: ASTM C618, Class C or F including supplementary optional physical requirements.
  - 2. Silica Fume: ASTM C1240.
- C. Coarse Aggregate: ASTM C33/C33M; size to suit application.
- D. Fine Aggregate: ASTM C33/C33M.
- E. Mixing Water: Fresh, clean, and potable.
- F. Air-Entraining Admixture: ASTM C260/C260M.
- G. Chemical Admixtures: ASTM C494/C494M.
- H. Reinforcing Steel: ASTM A615/A615M or ASTM A996/A996M, Grade 420 (60).
- I. Welded Wire Fabric: ASTM A1064/A1064M, plain; Grade 450 (65) sized as indicated.
- J. Expansion Joint Filler: ASTM D1751.
- K. Sheet Materials for Curing Concrete: ASTM C171.

## 2.2 SELECT SUBBASE

- A. Subbase: AASHTO M147; Grade E OR Grade F
  - 1. Select granular material composed of sand, sand-gravel, crushed stone, crushed or granulated slag, with or without soil binder, or combinations of these materials.

SUBBASE GRADING REQUIREMENTS							
Sieve Size		Percentage Passing by Mass					
		Grades					
(mm)	(in)	A	B	C	D	E	F
50	2	100	100				
25	1		75-95	100	100	100	100
9.5	3/8	30-65	40-75	50-85	60-100		
4.47	No. 4	25-55	30-60	35-65	50-85	55-100	70-100
2.00	No. 10	15-40	20-45	25-50	40-70	40-100	55-100
0.425	No. 40	8-20	15-30	15-30	25-45	20-50	30-70
0.075	No. 200	2-8	5-20	5-15	5-20	6-20	8-25

- B. Other Acceptable Gradations: Materials within three to five percent, plus or minus, of specified gradation, or as recommended by the geotechnical engineer and approved by the Contracting Officer's Representative.

## 2.3 FORMS

- A. Forms: Wood, plywood, metal, or other materials, approved by Contracting Officer's Representative, of grade or type suitable to obtain type of finish specified.
  - 1. Plywood: Exterior grade, free of defects and patches on contact surface.

2. Lumber: Sound, grade-marked, S4S stress graded softwood, minimum 50 mm (2 inches) thick, free from warp, twist, loose knots, splits, or other defects.
3. Form Coating: As recommended by Architect/Engineer.
- B. Provide forms suitable in cross-section, depth, and strength to resist springing during depositing and consolidating concrete.
  1. Do not use forms varying from straight line more than 3 mm in 3000 mm (1/8 inch in 10 feet), horizontally and vertically.
- C. Provide flexible or curved forms for forming radii.

## 2.4 CONCRETE CURING MATERIALS

- A. Concrete curing materials, conform to one of the following:
  1. Burlap: Minimum 233 g/sq. m (7 ounces/sq. yd.) dry.
  2. Sheet Materials for Curing Concrete: ASTM C171.
  3. Curing Compound: ASTM C309, Type 1; liquid membrane forming type, without paraffin or petroleum.

## 2.5 CONCRETE MIXES

- A. Design concrete mixes according to ASTM C94/C94M, Option C.
- B. Concrete Type: Air-entrained. See Table I.

TABLE I - CONCRETE TYPES					
Concrete Type	Minimum 28 Day Compressive Strength f'c MPa (psi)	Non-Air-Entrained		Air-Entrained	
		Min. Cement kg/cu. m (lbs./cu. yd.)	Max. Water Cement Ratio	Min. Cement kg/cu. m (lbs./cu. yd.)	Max. Water Cement Ratio
A	35 (5000)1,3	375 (630)	0.45	385 (650)	0.40
B	30 (4000)1,3	325 (550)	0.55	340 (570)	0.50
C	25 (3000)1,3	280 (470)	0.65	290 (490)	0.55
D	25 (3000)1,2	300 (500)	*	310 (520)	*
Footnotes:					
1. If trial mixes are used, achieve compressive strength 8.3 MPa (1,200 psi) in excess of f'c. For concrete strengths greater than 35 MPa (5,000 psi), achieve compressive strength 9.7 MPa (1,400 psi) in excess of f'c.					
2. For Concrete Exposed to High Sulfate Content Soils: Maximum water cement ratio is 0.44.					
3. Laboratory Determined according to ACI 211.1 for normal weight concrete.					



- C. Maximum Slump: ASTM C143/C143M. See Table II.

TABLE II - MAXIMUM SLUMP	
APPLICATION	MAXIMUM SLUMP
Curb & Gutter	75 mm (3 inches)
Pedestrian Pavement	75 mm (3 inches)
Vehicular Pavement	50 mm (2 inches) Machine Finished
	100 mm (4 inches) Hand Finished
Equipment Pad	75 to 100 mm (3 to 4 inches)

## 2.6 ACCESSORIES

- A. Equipment and Tools: Obtain Contracting Officer's Representative's, approval of equipment and tools needed for handling materials and performing work before work begins.
- B. Maintain equipment and tools in satisfactory working condition.
- C. Sealants:
  - 1. Concrete Paving Expansion Joints: ASTM D5893/D5893M, Type SL, single component, self-leveling, silicone joint sealant.
  - 2. Concrete Paving Joints: ASTM D6690, Type IV, hot-applied, single component joint sealant.
- D. Concrete Protective Coating: AASHTO M233 linseed oil mixture.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Examine and verify substrate suitability for product installation.
- B. Protect existing construction and completed work from damage.
- C. Prepare, construct, and finish subgrade. See Section 31 20 00, EARTHWORK.
- D. Maintain subgrade in smooth, compacted condition, in conformance with the required section and established grade until the succeeding operation has been accomplished.

### 3.2 SELECT SUBBASE

- A. Placing:
  - 1. Place subbase material on prepared subgrade in uniform layer to required contour and grades, and to maximum 200 mm (8 inches) loose depth.
  - 2. When required compacted thickness exceeds 150 mm (6 inches), place subbase material in equal thickness layers.
  - 3. When subbase elevation is 13 mm (1/2 inch) or more below required grade, excavate subbase minimum 75 mm (3 inches) deep. Place and compact subbase to required grade.
- B. Compaction:

1. Perform compaction with approved hand or mechanical equipment well suited to the material being compacted.
  2. Maintain subbase at optimum moisture content for compaction.
  3. Compact each subbase layer to minimum 95 percent or 100 percent of maximum density.
- C. Subbase Tolerances:
1. Variation from Indicated Grade: Maximum 9 mm (3/8 inch).
  2. Variation from Indicated Thickness: Maximum 13 mm (1/2 inch).
- D. Protection:
1. Protect subbase from damage until concrete is placed.
  2. Reconstruct damaged subbase before placing concrete.

### **3.3 SETTING FORMS**

- A. Form Substrate:
1. Compact form substrate to uniformly support forms along entire length.
  2. Correct substrate imperfections and variations by cutting, filling, and compacting.
- B. Form Setting:
1. Set forms to indicated line and grade with tight joints. Rigidly brace forms preventing movement.
  2. Remove forms when removal will not damage concrete and when required for finishing.
  3. Clean and oil forms before each use.
  4. Correct forms, when required, immediately before placing concrete.
- C. Form Tolerances:
1. Variation from Indicated Line: Maximum 6 mm (1/4 inch).
  2. Variation from Indicated Grade: Maximum 3 mm in 3000 mm (1/8 inch in 10 feet).

### **3.4 PLACING REINFORCEMENT**

- A. Keep reinforcement clean from contamination preventing concrete bond.
- B. Install reinforcement shown on drawings.
- C. Support and securely tie reinforcing steel to prevent displacement during concrete placement.
- D. Obtain Contracting Officer's Representative's reinforcement placement approval before placing concrete.

### **3.5 JOINTS - GENERAL**

- A. Place joints, where shown on approved submittal Drawings.
1. Conform to details shown.
  2. Install joints perpendicular to finished concrete surface.
- B. Make joints straight and continuous from edge to edge of pavement.

### **3.6 CONSTRUCTION JOINTS**

- A. Locate longitudinal and transverse construction joints between slabs of vehicular pavement as shown on approved submittal Drawings.
- B. Place transverse construction joints of type shown, where indicated, and whenever concrete placement is suspended for more than 30 minutes.

### **3.7 CONTRACTION JOINTS**

- A. Tool or cut joints to width, depth, and radius edge shown on drawings using grooving tool, jointer, or saw.
- B. Construct joints in curbs and gutters by inserting 3 mm (1/8 inch) steel plates conforming to curb and gutter cross sections.
  - 1. Keep plates in place until concrete can hold its shape.
- C. Finish joint edges with edging tool.
- D. Score pedestrian pavement with grooving tool or jointer.

### **3.8 EXPANSION JOINTS**

- A. Form expansion joints with expansion joint filler of thickness shown on drawings.
  - 1. Locate joints around perimeter of structures and features abutting site work concrete.
  - 2. Create complete, uniform separation between structure and site work concrete.
- B. Extend expansion joint material full depth of concrete with top edge of joint filler below finished concrete surface where sealant is indicated on Drawings.
- C. Cut and shape material matching cross section.
- D. Anchor with approved devices to prevent displacing during placing and finishing operations.
- E. Round joint edges with edging tool.

### **3.9 PLACING CONCRETE - GENERAL**

- A. Preparation before Placing Concrete:
  - 1. Obtain Contracting Officer's Representative approval.
  - 2. Remove debris and other foreign material.
  - 3. Uniformly moisten substrate, without standing water.
- B. Convey concrete from mixer to final location without segregation or loss of ingredients. Deposit concrete to minimize handling.
- C. During placement, consolidate concrete by spading or vibrating to minimize voids, honeycomb, and rock pockets.
  - 1. Vibrate concrete against forms and along joints.
  - 2. Avoid excess vibration and handling causing segregation.
- D. Place concrete continuously between joints without bulkheads.
- E. Install construction joint in concrete placement suspended for more than 30 minutes.

- F. Replace concrete with cracks, chips, bird baths, and other defects to nearest joints, approved by Contracting Officer's Representative.

### **3.10 PLACING CONCRETE FOR CURB AND GUTTER, PEDESTRIAN PAVEMENT, AND EQUIPMENT PADS**

- A. Place concrete in one layer conforming to cross section shown on Drawings after consolidating and finishing.
- B. Deposit concrete near joints without disturbing joints. Do not place concrete directly onto joint assemblies.
- C. Strike concrete surface to proper section ready for consolidation.
- D. Consolidate concrete with approved mechanical finishing equipment.
- E. Finish concrete surface with wood or metal float.
- F. Construct concrete pads and pavements with sufficient slope to drain, preventing standing water.

### **3.11 PLACING CONCRETE FOR VEHICULAR PAVEMENT**

- A. Deposit concrete as close as possible to its final position.
- B. Place concrete continuously between construction joints without cold joints.
- C. Strike and consolidate concrete with finishing machine, vibrating screed, or by hand-finishing.
- D. Finish concrete surface to elevation and crown shown on drawings.
- E. Deposit concrete near joints without disturbing joints. Do not place concrete directly onto joint assemblies.
- F. Obtain Contracting Officer's Representative's approval before placing adjacent lanes.

### **3.12 FORM REMOVAL**

- A. Keep forms in place minimum 12 hours after concrete placement. Remove forms without damaging concrete.
- B. Do not use bars or heavy tools against concrete to remove forms. Repair damage concrete found after form removal.

### **3.13 CONCRETE FINISHING - GENERAL**

- A. Follow operation sequence below, unless otherwise indicated on Drawings:
  - 1. Consolidating, floating, striking, troweling, texturing, and joint edging.
- B. Use edging tool with 6 mm (1/4 inch) radius.
- C. Keep finishing equipment and tools clean and suitable for use.

### **3.14 CONCRETE FINISHING - PEDESTRIAN PAVEMENT**

- A. Walks:
  - 1. Finish concrete surfaces with metal float, troweled smooth, and finished with a broom moistened with clear water.
  - 2. Finish slab edges and formed transverse joints with edger.

3. Broom surfaces transverse to traffic direction.
  - a. Use brooming to eliminate flat surface produced by edger.
  - b. Produce uniform corrugations, maximum 1.5 mm (1/16 inch) deep profile.
4. Provide surface uniform in color and free of surface blemishes, form marks, and tool marks.
5. Paving Tolerances:
  - a. Variation from Indicated Plane: Maximum 5 mm in 3000 mm (3/16 inch in 10 feet).
  - b. Variation from Indicated Thickness: Maximum 6 mm (1/4 inch).
6. Replace paving within joint boundary when paving exceeds specified tolerances.

### **3.15 CONCRETE FINISHING - VEHICULAR PAVEMENT**

- A. Align finish surfaces where new and existing pavements abut.
- B. Longitudinally float pavement surface to profile and grade indicated on drawings.
- C. Straighten surface removing irregularities and maintaining specified tolerances while concrete is plastic.
- D. Finish pavement edges and joints with edging tool.
- E. Broom finish concrete surface after bleed water dissipates and before concrete hardens.
  1. Broom surface transverse to traffic direction.
    - a. Use brooming to eliminate flat surface produced by edger.
    - b. Produce uniform corrugations, maximum 3 mm (1/8 inch) deep profile.
- F. Pavement Tolerances:
  1. Variation from Indicated Plane: Maximum 6 mm in 3000 mm (1/4 inch in 10 feet) tested parallel and perpendicular to traffic direction at maximum 1500 mm (5 feet) intervals.
  2. Variation from Indicated Thickness: Maximum 6 mm (1/4 inch).
- G. Replace paving within joint boundary when paving exceeds specified tolerances.

### **3.16 Not used**

### **3.17 CONCRETE FINISHING - EQUIPMENT PADS**

- A. Strike pad surface to elevation shown on Drawings.
- B. Provide smooth, dense float finish, free from depressions or irregularities.
- C. Finish pad edges with edger.
- D. After removing forms, rub pad edge faces with wood or concrete rubbing block, removing blemishes, form marks, and tool marks and providing uniform color.
- E. Pad Tolerances:
  1. See Plan
- F. Replace pads when pads exceed specified tolerances.

### **3.18 CONCRETE CURING**

- A. Concrete Protection:

1. Protect unhardened concrete from rain and flowing water.
  2. Provide sufficient curing and protection materials available and ready for use before concrete placement begins.
  3. Protect concrete to prevent pavement cracking from ambient temperature changes during curing period.
    - a. Replace pavement damaged by curing method allowing concrete cracking.
    - b. Employ another curing method as directed by Contracting Officer's Representative.
- B. Cure concrete for minimum 7 days by one of the following methods appropriate to weather conditions preventing moisture loss and rapid temperature change:
1. Burlap Mat: Provide minimum two layers kept saturated with water during curing period. Overlap Mats at least 150 mm (6 inches).
  2. Sheet Materials:
    - a. Wet exposed concrete surface with fine water spray and cover with sheet materials.
    - b. Overlap sheets minimum 300 mm (12 inches).
    - c. Securely anchor sheet materials preventing displacement.
  3. Curing Compound:
    - a. Protect joints indicated to receive sealants preventing contamination from curing compound.
    - b. Insert moistened paper or fiber rope into joint or cover joint with waterproof paper.
    - c. Apply curing compound before concrete dries.
    - d. Apply curing compound in two coats at right angles to each other.
    - e. Application Rate: Maximum 5 sq. m/L (200 sq. ft./gallon), both coats.
    - f. Immediately reapply curing compound to surfaces damaged during curing period.

**3.19 Not Used**

**3.20 FIELD QUALITY CONTROL**

- A. Field Tests: Performed by testing laboratory specified in Section 01 45 29, TESTING LABORATORY SERVICES.
1. Compaction.
    - a. Pavement subgrade.
    - b. Curb, gutter, and sidewalk.
  2. Concrete:
    - a. Delivery samples.
    - b. Field samples.

**3.21 CLEANING**

- A. After completing curing:

1. Remove burlap and sheet curing materials.
2. Sweep concrete clean, removing foreign matter from the joints.
3. Seal joints as specified.

**3.22 PROTECTION**

- A. Protect exterior improvements from traffic and construction operations.
  1. Prohibit traffic on paving for minimum seven days after placement, or longer as directed by Contracting Officer's Representative.
- B. Remove protective materials immediately before acceptance.
- C. Repair damage.
  1. Replace concrete containing excessive cracking, fractures, spalling, and other defects within joint boundary, when directed by Contracting Officer's Representative, and at no additional cost to the Government.

--- E N D ---

## **SECTION 32 12 16 ASPHALT PAVING**

### **PART 1 - GENERAL**

#### **1.1 DESCRIPTION**

This work shall cover the composition, mixing, construction upon the prepared subgrade, and the protection of hot asphalt concrete pavement. The hot asphalt concrete pavement shall consist of an aggregate or asphalt base course and asphalt surface course constructed in conformity with the lines, grades, thickness, and cross sections as shown. Each course shall be constructed to the depth, section, or elevation required by the drawings and shall be rolled, finished, and approved before the placement of the next course.

#### **1.2 RELATED WORK**

- A. Laboratory and field testing requirements: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Subgrade Preparation: Paragraph 3.3 and Section 31 20 00, EARTH MOVING.

#### **1.3 INSPECTION OF PLANT AND EQUIPMENT**

The VA shall have access at all times to all parts of the material producing plants for checking the mixing operations and materials and the adequacy of the equipment in use.

#### **1.4 ALIGNMENT AND GRADE CONTROL**

The Contractor shall establish and control the pavement (aggregate or asphalt base course and asphalt surface course) alignments, grades, elevations, and cross sections as shown on the Drawings.

#### **1.5 SUBMITTALS**

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
- B. Data and Test Reports:
  - 1. Aggregate Base Course: Sources, gradation, liquid limit, plasticity index, percentage of wear, and other tests required by State Highway Department.
  - 2. Asphalt Base/Surface Course: Aggregate source, gradation, soundness loss, percentage of wear, and other tests required by State Highway Department.
  - 3. Job-mix formula.
- C. Certifications:
  - 1. Asphalt prime and tack coat material certificate of conformance to State Highway Department requirements.
  - 2. Asphalt cement certificate of conformance to State Highway Department requirements.
- D. One copy of State Highway Department Specifications.



- E. Provide MSDS (Material Safety Data Sheets) for all chemicals used on ground.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. Aggregate base, Asphaltic base and asphalt concrete materials shall conform to the requirements of the following and other appropriate sections of the latest version of the State Highway Material Specifications, including amendments, addenda and errata. Where the term "Engineer" or "Commission" is referenced in the State Highway Specifications, it shall mean the VA Contracting Officer's Representative or VA Contracting Officer.

### **2.2 AGGREGATES**

- A. Provide aggregates consisting of crushed stone, gravel, sand, or other sound, durable mineral materials processed and blended, and naturally combined.
- B. Subbase aggregate (where required) maximum size: 38mm(1-1/2").
- C. Base aggregate maximum size:
1. Base course over 152mm(6") thick: 38mm(1-1/2");
  2. Other base courses: 19mm(3/4").
- D. Asphaltic base course:
1. Maximum particle size not to exceed 25.4mm(1").
  2. Where conflicts arise between this specification and the requirements in the latest version of the State Highway Specifications, the State Specifications shall control.
- E. Aggregates for asphaltic concrete paving: Provide a mixture of sand, mineral aggregate, and liquid asphalt mixed in such proportions that the percentage by weight will be within:

<u>Sieve Sizes</u>	<u>Percentage Passing</u>
19mm(3/4")	100
9.5mm(3/8")	67 to 85
6.4mm(1/4")	50 to 65
2.4mm(No. 8 mesh)	37 to 50
600µm(No. 30 mesh)	15 to 25
75µm(No. 200 mesh)	3 to 8

plus 50/60 penetration liquid asphalt at 5 percent to 6-1/2 percent of the combined dry aggregates.

### **2.3 ASPHALTS**

- A. Comply with provisions of Asphalt Institute Specification SS2:
1. Asphalt cement: Penetration grade 50/60
  2. Prime coat: Cut-back type, grade MC-250
  3. Tack coat: Uniformly emulsified, grade SS-1H

## **2.4 SEALER**

- A. Provide a sealer consisting of suitable fibrated chemical type asphalt base binders and fillers having a container consistency suitable for troweling after thorough stirring, and containing no clay or other deleterious substance.
- B. Where conflicts arise between this specification and the requirements in the latest version of the State Highway Specifications, the State Specifications shall control.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

The Asphalt Concrete Paving equipment, weather limitations, job-mix formula, mixing, construction methods, compaction, finishing, tolerance, and protection shall conform to the requirements of the appropriate sections of the State Highway Specifications for the type of material specified.

### **3.2 MIXING ASPHALTIC CONCRETE MATERIALS**

- A. Provide hot plant-mixed asphaltic concrete paving materials.
  - 1. Temperature leaving the plant: 143 degrees C(290 degrees F) minimum, 160 degrees C(320 degrees F) maximum.
  - 2. Temperature at time of placing: 138 degrees C(280 degrees F) minimum.

### **3.3 SUBGRADE**

- A. Shape to line and grade and compact with self-propelled rollers.
- B. All depressions that develop under rolling shall be filled with acceptable material and the area re-rolled.
- C. Soft areas shall be removed and filled with acceptable materials and the area re-rolled.
- D. Should the subgrade become rutted or displaced prior to the placing of the subbase, it shall be reworked to bring to line and grade.
- E. Proof-roll the subgrade with maximum 45 tonne (50 ton) gross weight dump truck as directed by VA Resident Engineer or VA Contracting Officer. If pumping, pushing, or other movement is observed, rework the area to provide a stable and compacted subgrade.

### **3.4 BASE COURSES**

- A. Subbase (when required)
  - 1. Spread and compact to the thickness shown on the drawings.
  - 2. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller.
  - 3. After completion of the subbase rolling there shall be no hauling over the subbase other than the delivery of material for the top course.
- B. Base
  - 1. Spread and compact to the thickness shown on the drawings.

2. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller.
3. After completion of the base rolling there shall be no hauling over the base other than the delivery of material for the top course.
- C. Thickness tolerance: Provide the compacted thicknesses shown on the Drawings within a tolerance of minus 0.0mm (0.0") to plus 12.7mm (0.5").
- D. Smoothness tolerance: Provide the lines and grades shown on the Drawings within a tolerance of 5mm in 3m (3/16 inch in ten feet).
- E. Moisture content: Use only the amount of moisture needed to achieve the specified compaction.

### **3.5 PLACEMENT OF ASPHALTIC CONCRETE PAVING**

- A. Remove all loose materials from the compacted base.
- B. Apply the specified prime coat, and tack coat where required, and allow to dry in accordance with the manufacturer's recommendations as approved by the Architect or Engineer.
- C. Receipt of asphaltic concrete materials:
  1. Do not accept material unless it is covered with a tarpaulin until unloaded, and unless the material has a temperature of not less than 130 degrees C(280 degrees F).
  2. Do not commence placement of asphaltic concrete materials when the atmospheric temperature is below 10 degrees C (50 degrees F), not during fog, rain, or other unsuitable conditions.
- D. Spreading:
  1. Spread material in a manner that requires the least handling.
  2. Where thickness of finished paving will be 76mm (3") or less, spread in one layer.
- E. Rolling:
  1. After the material has been spread to the proper depth, roll until the surface is hard, smooth, unyielding, and true to the thickness and elevations shown on the drawings.
  2. Roll in at least two directions until no roller marks are visible.
  3. Finished paving smoothness tolerance:
    - a. No depressions which will retain standing water.
    - b. No deviation greater than 3mm in 1.8m (1/8" in six feet).

### **3.6 NOT USED**

### **3.7 PROTECTION**

Protect the asphaltic concrete paved areas from traffic until the sealer is set and cured and does not pick up under foot or wheeled traffic.

### **3.8 FINAL CLEAN-UP**

Remove all debris, rubbish, and excess material from the work area.

--- E N D ---

**SECTION 33 40 00**  
**STORM DRAINAGE UTILITIES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

This section specifies construction of outside, underground storm sewer systems. The storm sewer systems shall be complete and ready for operation, including all drainage structures, frames, grate and covers, connections to new buildings, structure service lines, existing storm sewer lines and existing drainage structures and all required incidentals.

**1.2 RELATED WORK:**

- A. Maintenance of Existing Utilities: Section 01 00 00, GENERAL REQUIREMENTS.
- B. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 31 20 00, EARTH MOVING.
- C. Concrete Work, Reinforcing, Placement and Finishing: Section 03 30 00, CAST-IN-PLACE CONCRETE.
- D. Fabrication of Steel Ladders: Section 05 50 00, METAL FABRICATIONS.

**1.3 QUALITY ASSURANCE:**

- A. Products Criteria:
  - 1. Multiple Units: When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
  - 2. Nameplates: Nameplate bearing manufacturer's name, or identifiable trademark, securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.
- B. Comply with the rules and regulations of the Public Utility having jurisdiction over the connection to public storm sewer lines and the extension, and/or modifications to Public Utility systems.

**1.4 SUBMITTALS:**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturers' Literature and Data: Submit the following as one package:
  - 1. Piping.
  - 2. Jointing material.
  - 3. Manhole, inlet and catch basin material.
  - 4. Frames and covers.
  - 5. Steps.
  - 6. Resilient connectors and downspout boots.
- C. One copy of State Department of Transportation standard details of MANHOLES, INLETS and catch basins.
- D. One copy of State Department of Transportation specification.

### 1.5 APPLICABLE PUBLICATIONS:

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
- A48-03/A48M-03 ..... Gray Iron Castings
  - A536-84(2004) ..... Ductile Iron Castings
  - A615-05/A615M-05 ..... Deformed and Plain-Billet Steel Bars for Concrete Reinforcement
  - A655-04e1/A655M-04e1... Reinforced Concrete D-Load Culvert, Storm Drain and Sewer Pipe
  - A742-03/A742M-03 ..... Steel Sheet, Metallic Coated and Polymer Precoated for Corrugated Steel Pipe
  - A760-01a/A760M-01a ..... Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains
  - A762-00/A762M-00 ..... Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains
  - A798-01/M798M-01 ..... Installing Factory-Made Corrugated Steel Pipe for Sewers and Other Applications
  - A849-00 ..... Post-Applied Coatings, Pavings, and Linings for Corrugated Steel Sewer and Drainage Pipe
  - A929-01/A929M-01 ..... Steel Sheet, Metallic Coated by the Hot Dip Process for Corrugated Steel Pipe
  - C76-05a/C76M-05a ..... Reinforced Concrete Culvert, Storm Drain and Sewer Pipe
  - C139-03 ..... Concrete Masonry Units for Construction of Catch Basins and Manholes
  - C150-04ae1 ..... Portland Cement
  - C443-05/C443M-05 ..... Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
  - C478-03a/C478M-03a ..... Precast Reinforced Concrete Manhole Sections
  - C506-05/C506M-05 ..... Reinforced Concrete Arch Culvert, Storm Drain and Sewer Pipe
  - C507-05a/C507M-05a ..... Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe
  - C655-04e1/C655M-04e1 ..... Reinforced Concrete D-Load Culvert, Storm Drain and Sewer Pipe
  - C1433-04e1/C1433M-04e1 ..... Precast Reinforced Concrete Box Sections for Culverts, Storm Drains and Sewers
  - C828-03 ..... Low-Pressure Air Test of Vitrified Clay Pipe Lines
  - C857-95(2001) ..... Minimum Structural Design Loading for Underground Precast Concrete Utility Structures

C923-02/C923M-02 .....	Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes and Materials
C924-02/C924M-02 .....	Testing Concrete Pipe Sewer Lines by Low Pressure Air Test Method
C1103-03/C1103M-03 .....	Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
D698-00ae1 .....	Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft <sup>3</sup> (600 kN-m/m <sup>3</sup> ))
D1056-00 .....	Flexible Cellular Materials-Sponge or Expanded Rubber
D2412-02 .....	Determination of External Loading Characteristics of Plastic Pipe by Parallel Plate Loading
D2321-04e1 .....	Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Applications .
D3034-04a .....	Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
D3212-96a(2003)e1 .....	Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
D3350-04 .....	Polyethylene Plastics Pipe and Fittings Materials
D4101-05a .....	Polypropylene Injection and Extrusion Materials
F477-02e1 .....	Elastomeric Seals (Gaskets) for Joining Plastic Pipe
F679-03 .....	Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
F714-05 .....	Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
F794-03 .....	Poly (Vinyl Chloride)(PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
F894-98a .....	Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
F949-03 .....	Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with Smooth Interior
F1417-92(2005) .....	Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air

NOTE: ASTM test methods shall be the current version as of the date of advertisement of the project.

C. American Association of State Highway and Transportation Officials (AASHTO):

HB17 .....	Standard Specifications for Highway Bridges
M190-04 .....	Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches

M198-05 ..... Joints for Circular Concrete Sewer and Culvert Pipe Using  
Flexible Watertight Gaskets

M294-04 ..... Corrugated Polyethylene Pipe, 300-1500 mm (12 to 60 inches)  
Diameter

## PART 2 - PRODUCTS

### 2.1 PIPING:

#### A. Gravity Lines (Pipe and Appurtenances):

##### 1. High Density Polyethylene (HDPE):

- a. Smooth Wall PE Pipe: Shall comply with ASTM F714, DR 21 for pipes 75 to 600 mm (3 to 24 inches), and SDR 26 for pipes 650 to 1200 mm (26 to 48 inches). Pipe shall be produced from PE certified by the resin producer as meeting the requirements of ASTM D3350, minimum cell class 335434C.
- b. Corrugated PE Pipe: Shall comply with AASHTO M294, or Type S as appropriate for pipes 300 to 1500 mm (12 to 60 inches). Pipe walls shall have following minimum properties:

<u>Nominal Size</u>	<u>Minimum Wall Area</u>	<u>Min. Moment of Inertia mm<sup>4</sup>/mm (in<sup>4</sup>/in)</u>
300 mm (12 in)	3200 mm <sup>2</sup> /m (1.50 in <sup>2</sup> /ft)	390 (.024)
375 mm (15 in)	4000 mm <sup>2</sup> /m (1.91 in <sup>2</sup> /ft)	870 (.053)
450 mm (18 in)	4900 mm <sup>2</sup> /m (2.34 in <sup>2</sup> /ft)	1020 (.062)
600 mm (24 in)	6600 mm <sup>2</sup> /m (3.14 in <sup>2</sup> /ft)	1900 (.116)
750 mm (30 in)	8300 mm <sup>2</sup> /m (3.92 in <sup>2</sup> /ft)	2670 (.163)
900 mm (36 in)	9500 mm <sup>2</sup> /m (4.50 in <sup>2</sup> /ft)	3640 (.222)
1050 mm (42 in)	9900 mm <sup>2</sup> /m (4.69 in <sup>2</sup> /ft)	8900 (.543)
1200 mm (48 in)	10900 mm <sup>2</sup> /m (5.15 in <sup>2</sup> /ft)	8900 (.543)
1350 mm (54 in)	12000 mm <sup>2</sup> /m (5.67 in <sup>2</sup> /ft)	13110 (.800)
1500 mm (60 in)	13650 mm <sup>2</sup> /m (6.45 in <sup>2</sup> /ft)	13110 (.800)

- c. Profile Wall PE Pipe: Shall comply with ASTM F894, Class 160, produced from PE certified by the resin producer as meeting the requirements of ASTM D3350, Minimum cell class 334433C. Pipe walls shall have following minimum properties:

<u>Nominal Size</u>	<u>Minimum Wall Area</u>	<u>Min. Moment of Inertia mm<sup>4</sup>/mm (in<sup>4</sup>/in)</u>
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450 mm (18 in)	6300 mm <sup>2</sup> /m (2.96 in <sup>2</sup> /ft)	850 (.052)
525 mm (21 in)	8800 mm <sup>2</sup> /m (4.15 in <sup>2</sup> /ft)	1150 (.070)
600 mm (24 in)	9900 mm <sup>2</sup> /m (4.66 in <sup>2</sup> /ft)	1330 (.081)
675 mm (27 in)	12500 mm <sup>2</sup> /m (5.91 in <sup>2</sup> /ft)	2050 (.125)
750 mm (30 in)	12500 mm <sup>2</sup> /m (5.91 in <sup>2</sup> /ft)	2050 (.125)
825 mm (33 in)	14800 mm <sup>2</sup> /m (6.99 in <sup>2</sup> /ft)	2640 (.161)
900 mm (36 in)	17100 mm <sup>2</sup> /m (8.08 in <sup>2</sup> /ft)	3310 (.202)
1050 mm (42 in)	16500 mm <sup>2</sup> /m (7.81 in <sup>2</sup> /ft)	4540 (.277)
1200 mm (48 in)	18700 mm <sup>2</sup> /m (8.82 in <sup>2</sup> /ft)	5540 (.338)

## 2.2 JOINTING MATERIAL:

- A. Concrete Pipe: Rubber gasket ASTM C443.
- B. Polyvinyl Chloride (PVC) Pipe:
  - 1. PVC Plastic Pipe: Joints shall comply with ASTM D3212, Elastomeric Gaskets shall comply with ASTM F477 and as recommended by the manufacturer.
- C. PE Plastic Pipe:
  - 1. Smooth Wall PE Plastic Pipe: Pipe shall be joined using butt fusion as recommended by the manufacturer.
  - 2. Corrugated PE Plastic Pipe: Water tight joints shall be made using a PVC or PE coupling and rubber gaskets as recommended by the pipe manufacturer. Rubber gaskets shall conform to ASTM F477. Soil tight joints shall conform to requirements in AASHTO HB-17, Division II, for soil tightness and shall be as recommended by the manufacturer.
  - 3. Profile Wall PE Plastic Pipe: Joints shall be gasket or thermal weld type with integral bell in accordance with ASTM F894.

## 2.3 MANHOLES, INLETS AND CATCH BASINS:

- A. Manholes, inlets and catch basins shall be constructed of precast concrete segmental blocks, precast reinforced concrete rings, precast reinforced sections, or cast-in-place concrete. Manholes, inlets and catch basins shall be in accordance with State Department of Transportation standard details, and the following VA requirements, in case of variance, VA requirements supersede:
  - 1. Precast Concrete Segmental Blocks: Blocks shall conform to ASTM C139 and shall not be less than 150 mm (6 inches) thick for manholes to a depth of 3.6 m (12 feet); not less than 200 mm (8 inches) thick for manholes deeper than 3.6 m (12 feet) deep. Blocks shall be not less than 200 mm (8 inches) in length. Blocks shall be shaped so that joints seal and bond effectively with cement mortar. Pare structure interior and exterior with 15 mm (1/2 inch) of cement mortar applied with a trowel and finished to an even glazed surface.



2. Precast Reinforced Concrete Rings: Rings or sections shall have an inside diameter as indicated on the drawings, and shall be not less than 1200 mm (48 inches) in diameter. Wall thickness shall conform to requirements of ASTM C76, except that lengths of the sections may be shorter as conditions require. Tops shall conform to ASTM C478. Top section shall be eccentric cone type. Steps on inside wall shall be in the same plane from bottom of structure to manhole cover.
3. Precast Reinforced Concrete Manhole Risers and Tops: Design, material and installation shall conform to requirements of ASTM C478. Top sections shall be eccentric. Steps on inside wall shall be in the same plane from bottom of structure to manhole cover.
4. Flat top manhole tops shall be reinforced concrete as detailed on the drawings.
5. Precast Catch Basins: Concrete for precast sections shall have a minimum compressive strength of 35 MPa (5,000 psi) at 28 days, ASTM A615, Grade 60 reinforcing steel, rated for AASHTO HS20-44 loading with 30 percent impact, and conform to ASTM C-857.
6. Mortar:
  - a. Precast Concrete Segmental Block Structures: By volume, 1 part of Portland cement, 1/4 part lime hydrate, and 3 parts sand.
  - b. Precast Reinforced Concrete Ring and Riser Structures: By volume, 1 part of Portland cement and 2 parts sand. Water in mixture shall produce a stiff, workable mortar, but shall not exceed 21L (5-1/2 gallons) per sack of cement.
7. Flexible sealing compound shall be packaged in extruded preformed shape, sized to completely fill the joint between precast sections, and form permanently flexible watertight seal. The sealing compound shall be non-shrink and meet AASHTO M-198B.
8. Frames and covers shall be gray cast iron conforming to ASTM A48. The frame and cover shall be rated for HS20-44 loading, have a studded pattern on the cover, and the words "storm sewer". The studs and the lettering shall be raised 8 mm (5/16 inch). The cover shall be a minimum of 600 mm (24 inches) in diameter and shall have four 19 mm (3/4 inch) vent holes and two lifting slots. The bearing surface of the frame and cover shall be machine finished. The cover shall fit firmly on the frame without movement when subject to traffic.
9. Manhole steps shall be polypropylene plastic coated on a No. 4 deformed rebar conforming to ASTM C478, Polypropylene shall conform to ASTM D4101. Steps shall be a minimum of 250 mm (10 inches) wide and project a minimum of 125 mm (5 inches) away from the wall. The top surface of the step shall have a studded non-slip surface. Steps shall be placed at 300 mm (12 inch) centers.
10. Ladders, brackets and hardware shall be constructed of welded aluminum, rails shall be 9 mm (3/8 inch) by 63 mm (2-1/2 inches) spaced a minimum of 400 mm (16 inches) apart. Rungs shall be 35 mm (1-3/8 inches) in diameter and have a non-slip surface. Standoffs shall

offset the ladder 180 mm (7 inches) from the wall. The ladder assembly shall be rated for a minimum of 2200 N (500 pounds).

- B. Prefabricated Corrugated Metal Manholes: Manholes shall be the type and design as indicated on the drawings and as recommended by the manufacturer.
- C. Prefabricated Plastic Manholes and Drain Basins: Plastic manholes and drain basins shall be as indicated on the drawings.
- D. Frame and Cover for Gratings: Frame and cover for gratings shall be in accordance with Ohio Department of Transportation standard details.

#### **2.4 HEADWALLS:**

- A. Headwalls shall be cast-in-place concrete and in accordance with State Department of Transportation standard details. Concrete shall have a minimum compressive strength of 20 MPa (3000 psi) at 28 days. The cement shall be Type III conforming to ASTM C150. Concrete shall conform with the provisions of Division 03 of these specifications.

#### **2.5 CONCRETE:**

Concrete shall be in accordance with State Department of Transportation standard specification 706.02. For concrete not specified in above standards, concrete shall have a minimum compressive strength of 20 MPa (3000 psi) at 28 days. The cement shall be Type III conforming to ASTM C150. Concrete shall conform to the provisions of Division 03 of these specifications.

#### **2.6 REINFORCING STEEL:**

Reinforcing steel shall be deformed bars, ASTM A615, Grade 40 unless otherwise noted.

#### **2.7 FLARED END SECTIONS:**

Flared End Sections: Sections shall be of standard design fabricated from zinc-coated steel sheets conforming to requirements of ASTM A929.

#### **2.8 PRECAST REINFORCED CONCRETE BOX.**

Precast Reinforced Concrete Box: For highway loadings with 600 mm (2 feet) of cover or more subjected to dead load only, conform to ASTM C1433; For less than 600 mm (2 feet) of cover subjected to highway loading, conform to ASTM C1433.

#### **2.9 RESILIENT CONNECTORS AND DOWNSPOUT BOOTS:**

- A. Resilient Connectors: Flexible, watertight connectors used for connecting pipe to manholes and inlets shall conform to ASTM C923.
- B. Downspout Boots: Boots used to connect exterior downspouts to the storm drainage system shall be of gray cast iron conforming to ASTM A48, Class 30B or 35B.

#### **2.10 WARNING TAPE:**

Standard, 4-Mil polyethylene 76 mm (3 inch) wide tape detectable type, purple with black letters, and imprinted with "CAUTION BURIED STORM SEWER BELOW".

### **PART 3 - EXECUTION**

#### **3.1 EXCAVATION FOR STORM DRAINS AND DRAINAGE STRUCTURES:**

Excavation of trenches and for appurtenances and backfilling for storm drains, shall be in accordance with the applicable portions of Section 31 20 00, EARTH MOVING.

#### **3.2 PIPE BEDDING:**

The bedding surface of the pipe shall provide a firm foundation of uniform density throughout the entire length of pipe. Concrete pipe requirements are such that when no bedding class is specified, concrete pipe shall be bedded in a soil foundation accurately shaped and rounded to conform with the lowest one-fourth of the outside portion of circular pipe. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall not be more than the length, depth, and width required for properly making the particular type of joint. Plastic pipe bedding requirements shall meet the requirements of ASTM D2321. Bedding, haunching and initial backfill shall be either Class IB or Class II material. Corrugated metal pipe bedding requirements shall conform to ASTM A798.

#### **3.3 GENERAL PIPING INSTALLATION:**

- A. Lay pipes true to line and grade. Gravity flow sewer shall be laid with bells facing upgrade.
- B. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.
- C. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.
- D. Inspect pipes and fittings, for defects before installation. Defective materials shall be plainly marked and removed from the site. Cut pipe shall have smooth regular ends at right angles to axis of pipe.
- E. Clean interior of all pipe thoroughly before installation. When work is not in progress, open ends of pipe shall be closed securely to prevent entrance of storm water, dirt or other substances.
- F. Lower pipe into trench carefully and bring to proper line, grade, and joint. After jointing, interior of each pipe shall be thoroughly wiped or swabbed to remove any dirt, trash or excess jointing materials.
- G. Do not lay sewer pipe in same trench with another pipe or other utility.
- H. Do not walk on pipe in trenches until covered by layers of shading to a depth of 300 mm (12 inches) over the crown of the pipe.
- I. Install gravity sewer line in accordance with the provisions of these specifications and the following standards:
  - 1. Reinforced Concrete Pipe: Comply with manufacturer's recommendations with gasketed joints.
  - 2. Polyvinyl Chloride (PVC) Piping: ASTM D2321.

3. High Density Polyethylene (HDPE) Piping: Comply with manufacturer's recommendations with gasketed joints.

J. Warning tape shall be continuously placed 300 mm (12 inches) above storm sewer piping.

### **3.4 REGRADING:**

- A. Raise or lower existing manholes and structures frames and covers in regraded areas to finish grade. Carefully remove, clean and salvage cast iron frames and covers. Adjust the elevation of the top of the manhole or structure as detailed on the drawings. Reset cast iron frame and cover, grouting below and around the frame. Install concrete collar around reset frame and cover as specified for new construction.
- B. During periods when work is progressing on adjusting manholes or structures cover elevations, the Contractor shall install a temporary cover above the bench of the structure or manhole. The temporary cover shall be installed above the high flow elevation within the structure, and shall prevent debris from entering the wastewater stream.
- C. The Contractor shall comply with all OSHA confined space requirements when working within existing structures.

### **3.5 CONNECTIONS TO EXISTING VA-OWNED MANHOLES:**

Make pipe connections and alterations to existing manholes so that finished work will conform as nearly as practicable to the applicable requirements specified for new manholes, including concrete and masonry work, cutting, and shaping.

### **3.6 MANHOLES, INLETS AND CATCH BASINS:**

- A. General:
  1. Circular Structures:
    - a. Precast concrete segmental blocks shall lay true and plumb. All horizontal and vertical joints shall be completely filled with mortar. Parge interior and exterior of structure with 15 mm (1/2 inch) or cement mortar applied with a trowel and finished to an even glazed surface.
    - b. Precast reinforced concrete rings shall be installed true and plumb. The joints between rings and between rings and the base and top shall be sealed with a preform flexible gasket material specifically manufactured for this type of application. Adjust the length of the rings so that the eccentric conical top section will be at the required elevation. Cutting the conical top section is not acceptable.
    - c. Precast reinforced concrete manhole risers and tops. Install as specified for precast reinforced concrete rings.
  2. Rectangular Structures:
    - a. Reinforced concrete structures shall be installed in accordance with Division 03, CONCRETE of these specifications.

- b. Precast concrete structures shall be placed on a 200 mm (8 inch) reinforced concrete pad, or be provided with a precast concrete base section. Structures provided with a base section shall be set on a 200 mm (8 inches) thick aggregate base course compacted to a minimum of 95 percent of the maximum density as determined by ASTM D 698. Set precast section true and plumb. Seal all joints with preform flexible gasket material.
3. Do not build structures when air temperature is 0 degrees C (32 degrees F), or below.
4. Invert channels shall be smooth and semicircular in shape conforming to inside of adjacent sewer section. Make changes in direction of flow with a smooth curve of as large a radius as size of structure will permit. Make changes in size and grade of channels gradually and evenly. Construct invert channels by one of the listed methods:
  - a. Forming directly in concrete base of structure.
  - b. Building up with brick and mortar.
5. Floor of structure outside the channels shall be smooth and slope toward channels not less than 1:12 (25mm per 300mm, 1-inch per foot) nor more than 1:6 (50mm per 300mm, 2 inches per foot). Bottom slab and benches shall be concrete.
6. The wall that supports access rungs or ladder shall be 90 degrees vertical from the floor of structure to manhole cover.
7. Install steps and ladders per the manufacturer's recommendations. Steps and ladders shall not move or flex when used. All loose steps and ladders shall be replaced by the Contractor.
8. Install manhole frames and covers on a mortar bed, and flush with the finish pavement. Frames and covers shall not move when subject to vehicular traffic. Install a concrete collar around the frame to protect the frame from moving until the adjacent pavement is placed. In unpaved areas, the rim elevation shall be 50 mm (2 inches) above the adjacent finish grade. Install a 200 mm (8 inches) thick, by 300 mm (12 inches) concrete collar around the perimeter of the frame. Slope the top of the collar away from the frame.

### **3.7 CURB INLETS, CATCH BASINS, AND AREA DRAINS:**

Reinforced concrete as shown or precast concrete.

### **3.8 INSPECTION OF SEWERS:**

Inspect and obtain the COTR's approval. Thoroughly flush out before inspection. Lamp between structures and show full bore indicating sewer is true to line and grade. Lip at joints on inside of sewer is prohibited.

### **3.9 TESTING OF STORM SEWERS:**

- A. Gravity Sewers (Select one of the following):
  1. Air Test: Concrete Pipes conform to ASTM C924, Plastic Pipes conform to ASTM F1417, all other pipe material conform to ASTM C828 or C924, after consulting with pipe manufacturer. Testing of individual joints shall conform to ASTM C1103.

2. Exfiltration Test:

- a. Subject pipe to hydrostatic pressure produced by head of water at depth of 900 mm (3 feet) above invert of sewer at upper manhole under test. In areas where ground water exists, head of water shall be 900 mm (3 feet) above existing water table. Maintain head of water for one hour for full absorption by pipe body before testing. During 1 hour test period, measured maximum allowable rate of exfiltration for any section of sewer shall be 11L (3.0 gallons) per hour per 30 m (100 feet).
- b. If measurements indicate exfiltration is greater than maximum allowable leakage, take additional measurements until leaks are located. Repair and retest.

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