



**Department of  
Veterans Affairs**

## **Specifications**

**For: Polytrauma and Blind  
Rehabilitation Center /**

**PBRC BUILDING PREPARATION  
FOR ACTIVATION PROJECT**

**At: VA Medical Center – Palo Alto**

**3801 Miranda Avenue  
Palo Alto, California 94304**

Issue: 20 September 2011

Open Bids:

### Amendment

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**SECTION 01 00 00  
GENERAL REQUIREMENTS**

**1.1 GENERAL INTENTION**

- A. General Contractor shall completely prepare site for construction operations, including demolition and removal of existing structures, and furnish all labor and materials and perform work at the VA Palo Alto Health Care System, VA Medical Center, Palo Alto, California, as required by the drawings and specifications. Parking and staging areas are very limited on campus. Contractors will be required to park off-site and transport their employees to and from the VA medical center campus.

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B. Visits to the site by Bidders may be made only by appointment with the Resident Engineer's Office at the VA Medical Center, Palo Alto, CA.

D. All employees of general contractor and subcontractors shall comply with VA security management program and obtain permission of the VA police, be identified by project and employer, and restricted from unauthorized access.

E. Prior to commencing work, general contractor shall provide proof that a OSHA certified "competent person" (CP) (29 CFR 1926.20(b)(2)) will maintain a presence at the work site whenever the general or subcontractors are present.

F. Training:

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1. All employees of general contractor or subcontractors shall have the 10-hour OSHA certified Construction Safety course and /or other relevant competency training, as determined by VA CP with input from the ICRA team. The General Contractor's Competent Person shall have the 30-hour OSHA Certified Construction Safety course.
2. Submit training records of all such employees for approval before the start of work.

#### **1.4 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. For working outside the "regular hours" as defined in the contract, The General Contractor shall give 3 days notice to the Contracting Officer so that security arrangements can be provided for the employees. This notice is separate from any notices required for utility shutdown described later in this section.
3. No photography of VA premises is allowed without written permission of the Contracting Officer.

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4. 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.

D. Document Control:

1. Before starting any work, the General Contractor/Sub Contractors shall submit an electronic security memorandum describing the approach to following goals and maintaining confidentiality of "sensitive information".
2. The General Contractor is responsible for safekeeping of all drawings, project manual and other project information. This information shall be shared only with those with a specific need to accomplish the project.
3. Certain documents, sketches, videos or photographs and drawings may be marked "Law Enforcement Sensitive" or "Sensitive Unclassified". Secure such information in separate containers and limit the access to only those who will need it for the project. Return the information to the Contracting Officer upon request.
4. These security documents shall not be removed or transmitted from the project site without the written approval of Contracting Officer.

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5. All paper waste or electronic media such as CD's and diskettes shall be shredded and destroyed in a manner acceptable to the VA.
6. Notify Contracting Officer and Site Security Officer immediately when there is a loss or compromise of "sensitive information".
7. All electronic information shall be stored in specified location following VA standards and procedures using an Engineering Document Management Software (EDMS).
  - a. Security, access and maintenance of all project drawings, both scanned and electronic shall be performed and tracked through the EDMS system.
  - b. "Sensitive information" including drawings and other documents may be attached to e-mail provided all VA encryption procedures are followed.

F. Motor Vehicle Restrictions

1. Vehicle authorization request shall be required for any vehicle entering the site and such request shall be submitted 24 hours before the date and time of access. Access shall be restricted to picking up and dropping off materials and supplies.
2. **Due to a significant number of on-going major construction projects at the VA Medical Center, Palo Alto, there will be NO PARKING available on the medical center campus for the personal vehicles of the contractor and subcontractor's employees for the duration of this contract. An extremely limited number of contractor owned vehicles will be permitted as necessary for the prosecution of the work.**

### 1.5 FIRE SAFETY

A. Applicable Publications: Publications listed below form part of this Article to extent referenced. Publications are referenced in text by basic designations only.

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

E84-2009.....Surface Burning Characteristics of Building Materials

2. National Fire Protection Association (NFPA):

10-2010.....Standard for Portable Fire Extinguishers

30-2008.....Flammable and Combustible Liquids Code

51B-2009 .....Standard for Fire Prevention During Welding, Cutting and Other  
Hot Work

70-2011.....National Electrical Code

241-2009 .....Standard for Safeguarding Construction, Alteration, and  
Demolition Operations

3. Occupational Safety and Health Administration (OSHA):

29 CFR 1926.....Safety and Health Regulations for Construction

B. Documentation shall be provided to the Resident Engineer that individuals have undergone contractor's safety briefing.



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- C. 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.
- D. 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).
- E. Temporary Construction Partitions:
  - 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 as shown on drawings 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.
- F. Temporary Heating and Electrical: Install, use and maintain installations in accordance with 29 CFR 1926, NFPA 241 and NFPA 70.
- G. Means of Egress: Do not block exiting for occupied buildings, including paths from exits to roads. Minimize disruptions and coordinate with Resident Engineer.

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- H. Egress Routes for Construction Workers: Maintain free and unobstructed egress. Inspect daily. Report findings and corrective actions weekly to Resident Engineer.
- I. Fire Extinguishers: Provide and maintain extinguishers in construction areas and temporary storage areas in accordance with 29 CFR 1926, NFPA 241 and NFPA 10.
- J. Flammable and Combustible Liquids: Store, dispense and use liquids in accordance with 29 CFR 1926, NFPA 241 and NFPA 30.
- K. 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.
- 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 Resident Engineer. 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 Resident Engineer.
- M. Smoke Detectors: Prevent accidental operation. Remove temporary covers at end of work operations each day. Coordinate with Resident Project.
- N. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with Resident Engineer.  
  
Obtain permits from facility Safety Officer at least 48 hours in

advance. Designate contractor's responsible project-site fire

prevention program manager, to permit hot work.

- O. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and corrective actions weekly to the Resident Engineer.
- 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. Perform other construction, alteration and demolition operations in accordance with 29 CFR 1926.
- S. If required, submit documentation to the Resident Engineer that personnel have been trained in the fire safety aspects of working in areas with impaired structural or compartmentalization features.

#### **1.6 OPERATIONS AND STORAGE AREAS**

- A. The Contractor shall confine all operations (including storage of materials) on Government premises to areas authorized or approved by the Resident Engineer. 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 Resident Engineer and shall be built with labor and materials furnished by the Contractor without expense to the Government. 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. With the written consent of the Resident Engineer, the buildings and utilities may be abandoned and need not be removed.

- C. The Contractor shall, under regulations prescribed by the Resident Engineer, 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, or roads.

**(FAR 52.236-10)**

- D. Working space and space available for storing materials shall be as shown on the drawings or as determined by the Resident Engineer.
- 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 other contractors. 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 Resident Engineer where required by limited working space.
1. Do not store materials and equipment in other than assigned areas.

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2. 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.
  
- G. Utilities Services: Where necessary to cut existing pipes, electrical wires, conduits, cables, etc., of utility services, or of fire protection systems or communications systems, they shall be cut and capped at suitable places where shown; or, in absence of such indication, where directed by Resident Engineer. All such actions shall be coordinated with the Utility Company involved:
  1. Whenever it is required that a connection fee be paid to a public utility provider for new permanent service to the construction project, for such items as water, sewer, electricity, gas or steam, payment of such fee shall be the responsibility of the Government and not the Contractor.
  
- H. Sequence of Work: To insure such executions, Contractor shall furnish the Resident Engineer with a schedule of approximate 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 Resident Engineer a minimum of three weeks in advance of the proposed date of starting work in each specific area of site, building or portion thereof. Arrange such dates to insure accomplishment of this work in successive phases mutually agreeable to the Medical Center, Resident Engineer, and Contractor:

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- J. Utilities Services: Maintain existing utility services for 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 Resident Engineer.
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 Resident Engineer. 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 the Medical Center Director's prior knowledge and written approval. Refer to specification Sections 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, 27 05 11 REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS and 28 05 11, REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATIONS for additional requirements.
  2. Contractor shall submit a request to interrupt any such services to Resident Engineer, in writing, 96 hours 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 the Medical Center. Interruption time approved by Medical Center may occur at other than Contractor's normal working hours.

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4. Major interruptions of any system must be requested, in writing, at least 30 calendar days prior to the desired time and shall be performed as directed by the Resident Engineer.
  5. In case of a contract construction emergency, service will be interrupted on approval of Resident Engineer. Such approval will be confirmed in writing as soon as practical.
  6. Whenever it is required that a connection fee be paid to a public utility provider for new permanent service to the construction project, for such items as water, sewer, electricity, gas or steam, payment of such fee shall be the responsibility of the Government and not the Contractor.
- K. 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. 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.
- L. 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.
  2. Method and scheduling of required cutting, altering and removal of existing roads, walks and entrances must be approved by the Resident Engineer.

- N. Coordinate the work for this contract with other construction operations as directed by Resident Engineer. This includes the scheduling of traffic and the use of roadways, as specified in Article, USE OF ROADWAYS.

### **1.7 ALTERATIONS**

- A. Survey: Before any work is started, the Contractor shall make a thorough survey with the Resident Engineer of areas of buildings in which alterations occur and areas which are anticipated routes of access, and furnish a report, signed by both, 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 and Resident Engineer.
- 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 Resident Engineer, 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



**1.8 INFECTION PREVENTION MEASURES**

- A. Implement the requirements of VAMC's Infection Control Risk Assessment (ICRA) team. ICRA Group may monitor dust in the vicinity of the construction work and require the Contractor to take corrective action immediately if the safe levels are exceeded.
- B. Establish and maintain a dust control program as part of the contractor's infection preventive measures in accordance with the guidelines provided by ICRA Group as specified here. Prior to start of work, prepare a plan detailing project-specific dust protection measures, including periodic status reports, and submit to the Resident Engineer and Facility ICRA team for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
  1. All personnel involved in the construction or renovation activity shall be educated and trained in infection prevention measures established by the medical center.
- C. Medical center Infection Control personnel shall monitor for airborne disease (e.g. aspergillosis) as appropriate 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. In addition:
  1. The RE and VAMC Infection Control personnel shall review pressure differential monitoring documentation to verify that pressure differentials in the construction zone and in the patient-care rooms are appropriate for their settings. The requirement for negative air pressure in the construction zone shall depend on the location and type of activity. Upon notification, the contractor shall implement corrective measures to restore proper pressure differentials as needed.

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2. In case of any problem, the medical center, along with assistance from the contractor, shall conduct an environmental assessment to find and eliminate the source.
- D. In general, following preventive measures shall be adopted during construction to keep down dust and prevent mold.
1. Dampen debris to keep down dust and provide temporary construction partitions in existing structures where directed by Resident Engineer. Blank off ducts and diffusers to prevent circulation of dust into occupied areas during construction.
  2. Do not perform dust producing tasks within occupied areas without the approval of the Resident Engineer. For construction in any areas that will remain jointly occupied by the medical Center and Contractor's workers, the Contractor shall:
    - a. Provide dust proof one-hour fire-rated temporary drywall construction barriers to completely separate construction from the operational areas of the hospital in order to contain dirt debris and dust. Barriers shall be sealed and made presentable on hospital occupied side. Install a self-closing rated door in a metal frame, commensurate with the partition, to allow worker access. Maintain negative air at all times. A fire retardant polystyrene, 6-mil thick or greater plastic barrier meeting local fire codes may be used where dust control is the only hazard, and an agreement is reached with the Resident Engineer and Medical Center.
    - b. HEPA filtration is required where the exhaust dust may reenter the breathing zone. Contractor shall verify that construction exhaust to exterior is not reintroduced to the medical center through intake vents, or building openings. Install HEPA (High Efficiency Particulate Accumulator) filter vacuum system rated at 95% capture of 0.3 microns

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including pollen, mold spores and dust particles. Insure continuous negative air pressures occurring within the work area. HEPA filters should have ASHRAE 85 or other prefilter to extend the useful life of the HEPA. Provide both primary and secondary filtrations units. Exhaust hoses shall be heavy duty, flexible steel reinforced and exhausted so that dust is not reintroduced to the medical center.

- c. Adhesive Walk-off/Carpet Walk-off Mats, minimum 600mm x 900mm (24" x 36"), 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.
- d. 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 they are created. Transport these outside the construction area in containers with tightly fitting lids.
- e. The contractor shall not haul debris through patient-care areas without prior approval of the Resident Engineer 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.
- f. Using a HEPA vacuum, clean inside the barrier and vacuum ceiling tile prior to replacement. Any ceiling access panels opened for investigation beyond sealed areas shall be sealed immediately when unattended.

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- g. 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.
  - h. 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.
- E. 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.

**1.9 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 identified by attached tags or noted on drawings 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. Store such items where directed by Resident Engineer.

2. Items not reserved shall become property of the Contractor and be removed by Contractor from the 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 either relocated or reused will be removed by the Government in advance of work to avoid interfering with Contractor's operation.

#### **1.10 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.

**(FAR 52.236-9)**

- 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. Refer to FAR clause 52.236-7, "Permits and Responsibilities," which is included in General Conditions. A National Pollutant Discharge Elimination System (NPDES) permit is required for this project. The Contractor is considered an "operator" under the permit and has extensive responsibility for compliance with permit requirements. VA will make the permit application available at the (appropriate medical center) office. The apparent low bidder, contractor and affected subcontractors shall furnish all information and certifications that are required to comply with the permit process and permit requirements. Many of the permit requirements will be satisfied by completing construction as shown and specified. Some requirements involve the Contractor's method of operations and operations planning and the Contractor is responsible for employing best management practices. The affected activities often include, but are not limited to the following:

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- Designating areas for equipment maintenance and repair;
- Providing waste receptacles at convenient locations and provide regular collection of wastes;
- Locating equipment wash down areas on site, and provide appropriate control of wash-waters;
- Providing protected storage areas for chemicals, paints, solvents, fertilizers, and other potentially toxic materials; and
- Providing adequately maintained sanitary facilities.

**1.11 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 Resident Engineer. Existing work to be altered or extended and that is found to be defective in any way, shall be reported to the Resident Engineer 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.

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- 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 indicated on drawings and 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) of Section 00 72 00, GENERAL CONDITIONS.

**1.12 PHYSICAL DATA**



### **1.15 AS-BUILT DRAWINGS**

- A. The contractor shall maintain two 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 Resident Engineer's review, as often as requested.
- C. Contractor shall deliver two approved completed sets of as-built drawings to the Resident Engineer within 15 calendar days after each completed phase and after the acceptance of the project by the Resident Engineer.
- D. Paragraphs A, B, & C shall also apply to all shop drawings.

### **1.16 USE OF ROADWAYS**

- A. For hauling, use only established public roads and roads on Medical Center and, when authorized by the Resident Engineer, such temporary roads which are necessary in the performance of contract work. Temporary roads shall be constructed by the Contractor at Contractor's expense. When necessary to cross curbing, sidewalks, or similar construction, they must be protected by well-constructed bridges.
- B. When new permanent roads are to be a part of this contract, Contractor may construct them immediately for use to facilitate building operations. These roads may be used by all who have business thereon within zone of building operations.

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- C. When certain buildings (or parts of certain buildings) are required to be completed in advance of general date of completion, all roads leading thereto must be completed and available for use at time set for completion of such buildings or parts thereof.

**1.18 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 compliance with the following provisions:

1. Permission to use each unit or system must be given by Resident Engineer. If the equipment is not installed and maintained in accordance with the following provisions, the Resident Engineer 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. 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.

#### **1.19 TEMPORARY USE OF EXISTING ELEVATORS**

- A. Use of existing elevators for handling building materials and Contractor's personnel will be permitted subject to following provisions:
1. Contractor makes all arrangements with the Resident Engineer for use of elevators. The Resident Engineer will ascertain that elevators are in proper condition. Contractor may use elevators in Bldg. 2 designated by the Resident Engineer. Times when the elevators can be used will be determined by the Resident Engineer.
  2. Contractor covers and provides maximum protection of following elevator components:
    - a. Entrance jambs, heads soffits and threshold plates.
    - b. Entrance columns, canopy, return panels and inside surfaces of car enclosure walls.
    - c. Finish flooring.
  3. Government will accept hoisting ropes of elevator and rope of each speed governor if they are worn under normal operation. However, if these ropes are damaged by action of foreign

- matter such as sand, lime, grit, stones, etc., during temporary use, they shall be removed and replaced by new hoisting ropes.
4. If brake lining of elevators are excessively worn or damaged during temporary use, they shall be removed and replaced by new brake lining.
  5. All parts of main controller, starter, relay panel, selector, etc., worn or damaged during temporary use shall be removed and replaced with new parts, if recommended by elevator inspector after elevator is released by Contractor.
  6. Place elevator in condition equal, less normal wear, to that existing at time it was placed in service of Contractor as approved by Contracting Officer.

#### **1.20 TEMPORARY USE OF NEW ELEVATORS**

- A. The Contractor and his personnel shall be permitted use of new elevator(s) subject to the following provisions:
  1. Contractor shall make arrangements with the Resident Engineer for use of elevator(s). Contractor may obtain elevator(s) for exclusive use.
  2. Prior to the use of elevator(s), the Contractor shall have the elevator(s) inspected and accepted by an ASME accredited, certified elevator safety inspector. The acceptance report shall be submitted to the Resident Engineer.
  3. Submit to the Resident Engineer the schedule and procedures for maintaining equipment. Indicate the day or days of the week and total hours required for maintenance. A report

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- shall be submitted to the Resident Engineer monthly indicating the type of maintenance conducted, hours used, and any repairs made to the elevator(s).
4. The Contractor shall be responsible for enforcing the maintenance procedures.
  5. During temporary use of elevator(s) all repairs, equipment replacement and cost of maintenance shall be the responsibility of the Contractor.
  6. Personnel for operating elevator(s) shall not be provided by the Department of Veterans Affairs.
  7. Contractor shall cover and provide maximum protection of the entire elevator(s) installation.
  8. The Contractor shall arrange for the elevator company to perform operation of the elevator(s) so that an ASME accredited, certified elevator safety inspector can evaluate the equipment. The Contractor shall be responsible for any costs of the elevator company.
  9. All elevator(s) parts worn or damaged during temporary use shall be removed and replaced with new parts. This shall be determined by an ASME accredited certified elevator safety inspector after temporary use and before acceptance by the Government. Submit report to the Resident Engineer for approval.
  10. Elevator shall be tested as required by the testing section of the elevator(s) specifications before acceptance by the Department of Veterans Affairs.

**1.21 TEMPORARY TOILETS**

- A. Provide where directed, (for use of all Contractor's workmen) ample temporary sanitary toilet accommodations with suitable sewer and water connections; or, when approved by Resident

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Engineer, provide suitable dry closets where directed. 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.

**1.22 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 amount to be paid by the Contractor for chargeable electrical services shall be the prevailing rates charged to the Government. The Contractor shall carefully conserve any utilities furnished without charge.
- B. The Contractor, at Contractor's expense and in a workmanlike manner 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.
- 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. 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:
  - 1. Obtain heat by connecting to Medical Center heating distribution system.

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- a. Steam is available at no cost to Contractor.
- E. Electricity (for Construction and Testing): Furnish all temporary electric services.
- 1. 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. 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 Resident Engineer's discretion) of use of water from Medical Center's system.
- G. Steam: Furnish steam system for testing required in various sections of specifications.
- 1. Obtain steam for testing by connecting to the Medical Center steam distribution system. Steam is available at no cost to the Contractor.
  - 2. 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 Resident Engineer's discretion), of use of steam from the Medical Center's system.
- H. Fuel: Natural and LP gas and burner fuel oil required for boiler cleaning, normal initial boiler-burner setup and adjusting, and for performing the specified boiler tests will be furnished



by the Government. Fuel required for prolonged boiler-burner setup, adjustments, or modifications due to improper design or operation of boiler, burner, or control devices shall be furnished by the Contractor at Contractor's expense.

### 1.23 NEW TELEPHONE EQUIPMENT

The contractor shall coordinate with the work of installation of telephone equipment by others. This work shall be completed before the building is turned over to VA.

### 1.24 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 complex 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 complex 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.

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- D. All related components as defined above shall be functioning when any system component is tested. Tests shall be completed within a reasonably short period of time during which operating and environmental conditions remain reasonably constant.
- 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.

**1.25 INSTRUCTIONS**

- A. Contractor shall furnish Maintenance and Operating manuals and verbal instructions when required by the various sections of the specifications and as hereinafter specified.
- B. Manuals: Maintenance and operating manuals (four copies each) for each separate piece of equipment shall be delivered to the Resident Engineer 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.

### **1.27 RELOCATED EQUIPMENT ITEMS**

- A. Contractor shall disconnect, dismantle as necessary, remove and reinstall in new location, all existing equipment and items indicated on the drawings or specifications or otherwise 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 Resident Engineer.
- C. Suitably cap existing service lines, such as steam, condensate return, water, drain, gas, air, vacuum and/or electrical, 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.

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**SECTION 01 33 23**

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

- 1-1. Refer to Articles titled SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (FAR 52.236-21) and, SPECIAL NOTES (VAAR 852.236-91), in GENERAL CONDITIONS.
- 1-2. For the purposes of this contract, samples (including laboratory samples to be tested), test reports, certificates, and manufacturers' literature and data shall also be subject to the previously referenced requirements. The following text refers to all items collectively as SUBMITTALS.
- 1-3. Submit for approval, all of the items specifically mentioned under the separate sections of the specification, with information sufficient to evidence full compliance with contract requirements. Materials, fabricated articles and the like to be installed in permanent work shall equal those of approved submittals. After an item has been approved, no change in brand or make will be permitted unless:
  - A. Satisfactory written evidence is presented to, and approved by Contracting Officer, that manufacturer cannot make scheduled delivery of approved item or;
  - B. Item delivered has been rejected and substitution of a suitable item is an urgent necessity or;
  - C. Other conditions become apparent which indicates approval of such substitute item to be in best interest of the Government.
- 1-4. Forward submittals in sufficient time to permit proper consideration and approval action by Government. Time submission to assure adequate lead time for procurement of contract - required items. Delays attributable to untimely and rejected submittals will not serve as a basis for extending contract time for completion.
- 1-5. Submittals will be reviewed for compliance with contract requirements by Architect-Engineer, and action thereon will be taken by Resident Engineer on behalf of the Contracting Officer.
- 1-6. Upon receipt of submittals, Architect-Engineer will assign a file number thereto. Contractor, in any subsequent correspondence, shall refer to this file and identification number to expedite replies relative to previously approved or disapproved submittals.

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- 1-7. The Government reserves the right to require additional submittals, whether or not particularly mentioned in this contract. If additional submittals beyond those required by the contract are furnished pursuant to request therefor by Contracting Officer, adjustment in contract price and time will be made in accordance with Articles titled CHANGES (FAR 52.243-4) and CHANGES - SUPPLEMENT (VAAR 852.236-88) of the GENERAL CONDITIONS.
- 1-8. Schedules called for in specifications and shown on shop drawings shall be submitted for use and information of Department of Veterans Affairs and Architect-Engineer. However, the Contractor shall assume responsibility for coordinating and verifying schedules. The Contracting Officer and Architect-Engineer assumes no responsibility for checking schedules or layout drawings for exact sizes, exact numbers and detailed positioning of items.
- 1-9. Submittals must be submitted by Contractor only and shipped prepaid. Contracting Officer assumes no responsibility for checking quantities or exact numbers included in such submittals.
- A. Submit samples required by Section 09 06 00, SCHEDULE FOR FINISHES, in quadruplicate. Submit other samples in single units unless otherwise specified. Submit shop drawings, schedules, manufacturers' literature and data, and certificates in quadruplicate, except where a greater number is specified.
- B. Submittals will receive consideration only when covered by a transmittal letter signed by Contractor. Letter shall be sent via first class mail and FAX and shall contain the list of items, name of Medical Center, name of Contractor, contract number, applicable specification paragraph numbers, applicable drawing numbers (and other information required for exact identification of location for each item), manufacturer and brand, ASTM or Federal Specification Number (if any) and such additional information as may be required by specifications for particular item being furnished. In addition, catalogs shall be marked to indicate specific items submitted for approval.
1. A copy of letter must be enclosed with items, and any items received without identification letter will be considered "unclaimed goods" and held for a limited time only.
2. Each sample, certificate, manufacturers' literature and data shall be labeled to indicate the name and location of the Medical Center, name

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- of Contractor, manufacturer, brand, contract number and ASTM or Federal Specification Number as applicable and location(s) on project.
3. Required certificates shall be signed by an authorized representative of manufacturer or supplier of material, and by Contractor.
- C. In addition to complying with the applicable requirements specified in preceding Article 1.9, samples which are required to have Laboratory Tests (those preceded by symbol "LT" under the separate sections of the specification shall be tested, at the expense of Contractor, in a commercial laboratory approved by Contracting Officer.
1. Laboratory shall furnish Contracting Officer with a certificate stating that it is fully equipped and qualified to perform intended work, is fully acquainted with specification requirements and intended use of materials and is an independent establishment in no way connected with organization of Contractor or with manufacturer or supplier of materials to be tested.
  2. Certificates shall also set forth a list of comparable projects upon which laboratory has performed similar functions during past five years.
  3. Samples and laboratory tests shall be sent directly to approved commercial testing laboratory.
  4. Contractor shall send a copy of transmittal letter to both Resident Engineer and to Architect-Engineer simultaneously with submission of material to a commercial testing laboratory.
  5. Laboratory test reports shall be sent directly to Resident Engineer for appropriate action.
  6. Laboratory reports shall list contract specification test requirements and a comparative list of the laboratory test results. When tests show that the material meets specification requirements, the laboratory shall so certify on test report.
  7. Laboratory test reports shall also include a recommendation for approval or disapproval of tested item.
- D. If submittal samples have been disapproved, resubmit new samples as soon as possible after notification of disapproval. Such new samples shall be marked "Resubmitted Sample" in addition to containing other previously specified information required on label and in transmittal letter.
- E. Approved samples will be kept on file by the Resident Engineer at the site until completion of contract, at which time such samples will be delivered to Contractor as Contractor's property. Where noted in technical sections

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of specifications, approved samples in good condition may be used in their proper locations in contract work. At completion of contract, samples that are not approved will be returned to Contractor only upon request and at Contractor's expense. Such request should be made prior to completion of the contract. Disapproved samples that are not requested for return by Contractor will be discarded after completion of contract.

- F. Submittal drawings (shop, erection or setting drawings) and schedules, required for work of various trades, shall be checked before submission by technically qualified employees of Contractor for accuracy, completeness and compliance with contract requirements. These drawings and schedules shall be stamped and signed by Contractor certifying to such check.
1. For each drawing required, submit one legible photographic paper or vellum reproducible.
  2. Reproducible shall be full size.
  3. Each drawing shall have marked thereon, proper descriptive title, including Medical Center location, project number, manufacturer's number, reference to contract drawing number, detail Section Number, and Specification Section Number.
  4. A space 120 mm by 125 mm (4-3/4 by 5 inches) shall be reserved on each drawing to accommodate approval or disapproval stamp.
  5. Submit drawings, ROLLED WITHIN A MAILING TUBE, fully protected for shipment.
  6. One reproducible print of approved or disapproved shop drawings will be forwarded to Contractor.
  7. When work is directly related and involves more than one trade, shop drawings shall be submitted to Architect-Engineer under one cover.

- 1-10. Samples (except laboratory samples), shop drawings, test reports, certificates and manufacturers' literature and data, shall be submitted for approval to:

SmithGroup, Inc,  
301 Battery St., 7<sup>th</sup> floor,  
San Francisco, CA 94111,  
Attn: Ahmad Jahrhomi / Jon Gherga

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1-11. At the time of transmittal to the architect-engineer, the Contractor shall also send a copy of the complete submittal directly to the Resident Engineer.

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**SECTION 01 42 19**

**REFERENCE STANDARDS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. 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)**

- A. 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)  
811 Vermont Avenue, NW - Room 462  
Washington, DC 20420  
Telephone Numbers: (202) 461-8217 or (202) 461-8292  
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.

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AA Aluminum Association Inc.  
<http://www.aluminum.org>

AABC Associated Air Balance Council  
<http://www.aabchg.com>

AAMA American Architectural Manufacturer's Association  
<http://www.aamanet.org>

AAN American Nursery and Landscape Association  
<http://www.anla.org>

AASHTO American Association of State Highway and Transportation  
Officials  
<http://www.aashto.org>

AATCC American Association of Textile Chemists and Colorists  
<http://www.aatcc.org>

ACGIH American Conference of Governmental Industrial Hygienists  
<http://www.acgih.org>

ACI American Concrete Institute  
<http://www.aci-int.net>

ACPA American Concrete Pipe Association  
<http://www.concrete-pipe.org>

ACPPA American Concrete Pressure Pipe Association  
<http://www.acppa.org>

ADC Air Diffusion Council  
<http://flexibleduct.org>

AGA American Gas Association  
<http://www.aga.org>

AGC Associated General Contractors of America  
<http://www.agc.org>

AGMA American Gear Manufacturers Association, Inc.  
<http://www.agma.org>

AHAM Association of Home Appliance Manufacturers  
<http://www.aham.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>

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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  
<http://www.astm.org>

AWI Architectural Woodwork Institute  
<http://www.awinet.org>

AWS American Welding Society  
<http://www.aws.org>

AWWA American Water Works Association  
<http://www.awwa.org>

BHMA Builders Hardware Manufacturers Association  
<http://www.buildershardware.com>

BIA Brick Institute of America  
<http://www.bia.org>

CAGI Compressed Air and Gas Institute  
<http://www.cagi.org>

CGA Compressed Gas Association, Inc.  
<http://www.cganet.com>

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CI The Chlorine Institute, Inc.  
<http://www.chlorineinstitute.org>

CISCA Ceilings and Interior Systems Construction Association  
<http://www.cisca.org>

CISPI Cast Iron Soil Pipe Institute  
<http://www.cispi.org>

CLFMI Chain Link Fence Manufacturers Institute  
<http://www.chainlinkinfo.org>

CPMB Concrete Plant Manufacturers Bureau  
<http://www.cpmc.org>

CRA California Redwood Association  
<http://www.calredwood.org>

CRSI Concrete Reinforcing Steel Institute  
<http://www.crsi.org>

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.etl.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>

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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  
<http://www.icbo.org>

ICEA Insulated Cable Engineers Association Inc.  
<http://www.icea.net>

ICAC Institute of Clean Air Companies  
<http://www.icac.com>

IEEE Institute of Electrical and Electronics Engineers  
<http://www.ieee.org>

IMSA International Municipal Signal Association  
<http://www.imsasafety.org>

IPCEA Insulated Power Cable Engineers Association

NBMA Metal Buildings Manufacturers Association  
<http://www.mbma.com>

MSS Manufacturers Standardization Society of the Valve and Fittings  
Industry Inc.  
<http://www.mss-hq.com>

NAAMM National Association of Architectural Metal Manufacturers  
<http://www.naamm.org>

NAPHCC Plumbing-Heating-Cooling Contractors Association  
<http://www.phccweb.org>

NBS National Bureau of Standards  
See - NIST

NBBPVI National Board of Boiler and Pressure Vessel Inspectors  
<http://www.nationboard.org>

NEC National Electric Code  
See - NFPA National Fire Protection Association

NEMA National Electrical Manufacturers Association  
<http://www.nema.org>

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NFPA National Fire Protection Association  
<http://www.nfpa.org>

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>

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SCMA Southern Cypress Manufacturers Association  
<http://www.cypressinfo.org>

SDI Steel Door Institute  
<http://www.steeldoor.org>

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  
<http://www.ul.com>

ULC Underwriters' Laboratories of Canada  
<http://www.ulc.ca>

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



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WWPA Western Wood Products Association  
<http://www.wwpa.org>

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**SECTION 01 45 29**

**TESTING LABORATORY SERVICES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

- A. This section specifies materials testing activities and inspection services required during project construction to be provided by a Testing Laboratory retained and paid for by 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):
1. T27-06 Sieve Analysis of Fine and Coarse Aggregates
  2. T96-02 (R2006) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
  3. T99-01 (R2004) The Moisture-Density Relations of Soils Using a 2.5 Kg (5.5 lb.) Rammer and a 305 mm (12 in.) Drop
  4. T104-99 (R2003) Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
  5. T180-01 (R2004) Moisture-Density Relations of Soils using a 4.54 kg (10 lb.) Rammer and a 457 mm (18 in.) Drop
  6. T191-02 (R2006) Density of Soil In-Place by the Sand-Cone Method
- C. American Society for Testing and Materials (ASTM):
1. A325-06 Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
  2. A370-07 Definitions for Mechanical Testing of Steel Products
  3. A490-06 Heat Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
  4. C31/C31M-06 Making and Curing Concrete Test Specimens in the Field
  5. C33-03 Concrete Aggregates
  6. C39/C39M-05 Compressive Strength of Cylindrical Concrete Specimens
  7. C109/C109M-05 Compressive Strength of Hydraulic Cement Mortars
  8. C138-07 Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
  9. C143/C143M-05 Slump of Hydraulic Cement Concrete

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10. C172-07 Sampling Freshly Mixed Concrete
  11. C173-07 Air Content of freshly Mixed Concrete by the Volumetric Method
  12. C330-05 Lightweight Aggregates for Structural Concrete
  13. C567-05 Density Structural Lightweight Concrete
  14. C1064/C1064M-05 Freshly Mixed Portland Cement Concrete
  15. C1077-06 Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
  16. D698-07 Laboratory Compaction Characteristics of Soil Using Standard Effort
  17. D1188-07 Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens
  18. D1556-07 Density and Unit Weight of Soil in Place by the Sand-Cone Method
  19. D1557-07 Laboratory Compaction Characteristics of Soil Using Modified Effort
  20. D2167-94 (R2001) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
  21. D2922-05 Density of soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
  22. D2974-07 Moisture, Ash, and Organic Matter of Peat and Other Organic Soils
  23. D3666- (2002) Minimum Requirements for Agencies Testing and Inspection Bituminous Paving Materials
  24. D3740-07 Minimum Requirements for Agencies Engaged in the Testing and Inspecting Road and Paving Material
  25. E94-04 Radiographic Testing
  26. E164-03 Ultrasonic Contact Examination of Weldments
  27. E329-07 Agencies Engaged in Construction Inspection and/or Testing
  28. E543-06 Agencies Performing Non-Destructive Testing
  29. E605-93 (R2006) Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members
  30. E709- (2001) Guide for Magnetic Particle Examination
  31. E1155-96 (R2008) Determining FF Floor Flatness and FL Floor Levelness Numbers

D. American Welding Society (AWS):

1. Structural Welding Code-Steel

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**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 Certification of Accreditation and Scope of Accreditation. The laboratory's scope of accreditation must include the appropriate ASTM standards ( i.e.E-329, C-1077, D-3666, D-3740, A-880, E-543 ) 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." Submit to the RE/COTR for approval, certified statements, signed by an official of the testing laboratory attesting that the proposed laboratory, meets or conforms to the ASTM standards listed below as appropriate to the testing field.
1. Laboratories engaged in testing of construction materials shall meet the requirements of ASTM E329.
  2. Laboratories engaged in testing of concrete and concrete aggregates shall meet the requirements of ASTM C1077.
  3. Laboratories engaged in testing of bituminous paving materials shall meet the requirements of ASTM D3666.
  4. Laboratories engaged in testing of soil and rock, as used in engineering design and construction, shall meet the requirements of ASTM D3740.
  5. Laboratories engaged in inspection and testing of steel, stainless steel, and related alloys will be evaluated according to ASTM A880.
  6. Laboratories engaged in non-destructive testing (NDT) shall meet the requirements of ASTM E543.
  7. Laboratories engaged in Hazardous Materials Testing shall meet the requirements of OSHA and EPA.
- B. Inspection and Testing: Testing laboratory shall inspect materials and workmanship and perform tests described herein and additional tests requested by RE/COTR. When it appears materials furnished, or work performed by Contractor fail to meet construction contract requirements, Testing Laboratory shall direct attention of RE/COTR to such failure.
- C. Written Reports: Testing laboratory shall submit test reports to RE/COTR, Contractor, and Local Building Authority within 24 hours after each test is completed unless other arrangements are agreed to in writing by the RE/COTR. Submit reports of tests that fail to meet construction contract requirements on colored paper.
- D. Verbal Reports: Give verbal notification to RE/COTR immediately of any irregularity.
- E. Test Standards: The Contractor shall include a lump sum allowance of \$5000 for furnishing published standards (ASTM, AASHTO, ACI, ANSI, AWS, ASHRAE, UL, etc.) referred to or specifically referenced which are pertinent to any Sections of these specifications. Furnish one set of standards in single copies or bound volumes to the RE/COTR within 60 days. Photocopies are not

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acceptable. Billings for the standards furnished shall be at the net cost to Testing Laboratory. A preliminary list of test standards, with the estimated costs, shall be submitted to the RE/COTR for review before any publications of reference standards are ordered.

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

**PART 3 - EXECUTION**

**3.1 EARTHWORK:**

A. General: All earthwork, including site and subgrade preparation, foundation and retaining wall installation, and fill placement, shall be performed in accordance with the Geotechnical Report titled "Geotechnical Investigation, Ambulatory Care, Polytrauma, and Blind Rehabilitation Centers, Veterans Affairs Medical Center, Palo Alto, California" prepared by Treadwell & Rollo, Inc., dated 19 Feb. 2009. The Geotechnical Engineer 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 RE/COTR regarding suitability or unsuitability of areas where proof-rolling was observed. Where unsuitable results are observed, witness excavation of unsuitable material and recommend to RE/COTR extent of removal and replacement of unsuitable materials and observe proof-rolling of replaced areas until satisfactory results are obtained.
2. Provide full time observation of fill placement and compaction and field density testing in building areas and provide part time observation of fill placement and compaction and field density testing in pavement areas to verify that Testing Compaction:
3. Provide supervised geotechnical technician to inspect excavation, subsurface preparation, and backfill for structural fill.

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 D2922 wherever possible. Field density tests shall meet the optimum moisture content and relative compaction requirements specified in the geotechnical report. Field density tests utilizing ASTM D1556 , 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

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provide satisfactory explanation to the RE/COTR before the tests are conducted.

- a. Building Slab Subgrade: At least one test of subgrade for every 185m<sup>2</sup> (2000 square feet) of building slab, but in no case fewer than three tests. In each compacted fill layer, perform one test for every 185 m<sup>2</sup> (2000 square feet) of overlaying building slab, but in no case fewer than three tests.
- b. Foundation Wall Backfill: One test per 30 m (100 feet) of each layer of compacted fill but in no case fewer than two tests.
- c. Pavement Subgrade: One test for each 335 m<sup>2</sup> (400 square yards), but in no case fewer than two tests.
- d. Curb, Gutter, and Sidewalk: One test for each 90 m (300 feet), but in no case fewer than two tests.
- e. Trenches: One test at maximum 30 m (100 foot) intervals per 1200mm (4 foot) of vertical lift and at changes in required density, but in no case fewer than two tests.
- f. 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 RE/COTR. 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, bottoms and sides of excavation are moist, and correlate actual soil conditions observed with those indicated by test borings.

C. Testing for Footing Bearing Capacity: Evaluate if suitable bearing capacity material is encountered in footing subgrade.

D. Testing Materials: Test suitability of on-site and off-site borrow as directed by RE/COTR.

### 3.2 LANDSCAPING:

- A. Test topsoil for organic materials, pH, phosphate, potash content, and gradation of particles.
  1. Test for organic material by using ASTM D2974.
  2. Determine percent of silt, sand, clay, and foreign materials such as rock, roots, and vegetation.
  3. Submit laboratory test report of topsoil to RE/COTR.

### 3.3 ASPHALT CONCRETE PAVING:

- A. Aggregate Base Course:
  1. Determine maximum density and optimum moisture content for aggregate base material in accordance with ASTM D1557, Method D.
  2. Make a minimum of three field density tests on each day's final compaction on each aggregate course in accordance with ASTM D1556.
  3. Sample and test aggregate as necessary to insure compliance with specification requirements for gradation, wear, and soundness as

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specified in the applicable state highway standards and specifications.

B. Asphalt Concrete:

1. Aggregate: Sample and test aggregates in stock pile and hot-bins as necessary to insure compliance with specification requirements for gradation (AASHTO T27), wear (AASHTO T96), and soundness (AASHTO T104).
2. Temperature: Check temperature of each load of asphalt concrete at mixing plant and at site of paving operation.
3. Density: Make a minimum of two field density tests in accordance with ASTM D1188 of asphalt base and surface course for each day's paving operation.

**3.4 SITE WORK CONCRETE:**

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

**3.5 POST-TENSIONING OF CONCRETE:**

- A. Inspection Prior to Concreting: Inspect tendons, drape of tendons, and anchorage components for compliance prior to concreting.
- B. Concrete Testing: As required in Article, CONCRETE of this section except make three test cylinders representing each area to be tensioned and cylinders shall be cured in same manner as concrete they represent. Make compression test prior to determining minimum specified strength required for post-tensioning.
- C. Post-tensioning: Witness post-tensioning operation and record actual gauge pressures and elongations applied to each tendon.
- D. Submit reports in quadruplicate of the following:
1. Inspection of placement and post-tensioning of all tendons.
  2. Size, number, location, and drape of tendons.
  3. Calculated elongations, based upon the length, modulus of elasticity, and cross-sectional area of the tendons used.
  4. Actual field elongations. Check elongation of tendons within ranges established by manufacturer.
  5. Calculated gauge pressure and jacking force applied to each tendon.
  6. Actual gauge pressures and jacking force applied to each tendon.
  7. Required concrete strength at time of jacking.
  8. Actual concrete strength at time of jacking.
  9. Do not cut or cover the tendon ends until the Contractor receives the RE/COTR's written approval of the post-tensioning records.

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**3.6 CONCRETE:**

A. Batch Plant Inspection and Materials Testing:

1. Perform continuous batch plant inspection until concrete quality is established to satisfaction of RE/COTR with concurrence of Contracting Officer and perform periodic inspections thereafter as determined by RE/COTR.
2. Periodically inspect and test batch proportioning equipment for accuracy and report deficiencies to RE/COTR.
3. Sample and test mix ingredients as necessary to insure compliance with specifications.
4. Sample and test aggregates daily and as necessary for moisture content. Test the dry rodded weight of the coarse aggregate whenever a sieve analysis is made, and when it appears there has been a change in the aggregate.
5. Certify, in duplicate, ingredients and proportions and amounts of ingredients in concrete conform to approved trial mixes. When concrete is batched or mixed off immediate building site, certify (by signing, initialing or stamping thereon) on delivery slips (duplicate) that ingredients in truck-load mixes conform to proportions of aggregate weight, cement factor, and water-cement ratio of approved trial mixes.

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 40 m<sup>3</sup> (50 cubic yards) or less of each concrete type, and at least three cylinders for any one day's pour for each concrete type. After good concrete quality control has been established and maintained as determined by RE/COTR make three cylinders for each 80 m<sup>3</sup> (100 cubic yards) or less of each concrete type, and at least three cylinders from any one day's pour for each concrete type. Label each cylinder with an identification number. RE/COTR 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 for concrete not required to be



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- air-entrained, test every 80 m<sup>3</sup> (10<sup>0</sup> 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.
  18. Measure concrete flatwork for levelness and flatness as follows:

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- a. Perform Floor Tolerance Measurements  $F_F$  and  $F_L$  in accordance with ASTM E1155. Calculate the actual overall F-numbers using the inferior/superior area method.
  - b. Perform all floor tolerance measurements within 48 hours after slab installation and prior to removal of shoring and formwork.
  - c. Provide the Contractor and the RE/COTR with the results of all profile tests, including a running tabulation of the overall  $F_F$  and  $F_L$  values for all slabs installed to date, within 72 hours after each slab installation.
19. Other Inspections:
- a. Grouting under base plates.
  - b. Grouting anchor bolts and reinforcing steel in hardened concrete.
- 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 RE/COTR. 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 RE/COTR. 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.

### 3.7 REINFORCEMENT:

- A. Review mill test reports furnished by Contractor.
- B. Perform sampling at fabricating plant. Take two samples from each 23 t (25 tons) or fraction thereof of each size of reinforcing steel No. 10 thru No. 57 (No. 3 thru No. 18).
- C. Make one tensile and one bend test in accordance with ASTM A370 from each pair of samples obtained.

- D. Written report shall include, in addition to test results, heat number, manufacturer, type and grade of steel, and bar size.
- E. Perform tension tests of mechanical and welded splices in accordance with ASTM A370.

### 3.8 MASONRY:

- A. Mortar Tests:
  - 1. Laboratory compressive strength test:
    - a. Comply with ASTM C780.
    - b. Obtain samples during or immediately after discharge from batch mixer.
    - c. Furnish molds with 50 mm (2 inch), 3 compartment gang cube.
    - d. Test one sample at 7 days and 2 samples at 28 days.
  - 2. Two tests during first week of operation; one test per week after initial test until masonry completion.
- B. Grout Tests:
  - 1. Laboratory compressive strength test:
    - a. Comply with ASTM C1019.
    - b. Test one sample at 7 days and 2 samples at 28 days.
    - c. Perform test for each 230 m<sup>2</sup> (2500 square feet) of masonry.
- C. Masonry Unit Tests:
  - 1. Laboratory Compressive Strength Test:
    - a. Comply with ASTM C140.
    - b. Test 3 samples for each 460 m<sup>2</sup> (5000 square feet) of wall area.
- D. Prism Tests: For each type of wall construction indicated, test masonry prisms per ASTM C1314 for each 460 m<sup>2</sup> (5000 square feet) of wall area. Prepare one set of prisms for testing at 7 days and one set for testing at 28 days.

### 3.9 STRUCTURAL STEEL:

- A. General: Provide shop and field inspection and testing services to certify structural steel work is done in accordance with contract documents. Welding shall conform to AWS Structural Welding Code.
- B. Prefabrication Inspection:
  - 1. Review design and shop detail drawings for size, length, type and location of all welds to be made.
  - 2. Approve welding procedure qualifications either by pre-qualification or by witnessing qualifications tests.
  - 3. Approve welder qualifications by certification or retesting.
  - 4. Approve procedure for control of distortion and shrinkage stresses.

5. Approve procedures for welding in accordance with applicable sections of AWS D1.1.

C. Fabrication and Erection:

1. Weld Inspection:

- a. Inspect welding equipment for capacity, maintenance and working condition.
- b. Verify specified electrodes and handling and storage of electrodes in accordance with AWS D1.1.
- c. Inspect preparation and assembly of materials to be welded for conformance with AWS D1.1.
- d. Inspect preheating and interpass temperatures for conformance with AWS D1.1.
- e. Measure 25 percent of fillet welds.
- f. Welding Magnetic Particle Testing: Test in accordance with ASTM E709 for a minimum of:
  - 1) 20 percent of all shear plate fillet welds at random, final pass only.
  - 2) 20 percent of all continuity plate and bracing gusset plate fillet welds, at random, final pass only.
  - 3) 100 percent of tension member fillet welds (i.e., hanger connection plates and other similar connections) for root and final passes.
  - 4) 20 percent of length of built-up column member partial penetration and fillet welds at random for root and final passes.
  - 5) 100 percent of length of built-up girder member partial penetration and fillet welds for root and final passes.
- g. Welding Ultrasonic Testing: Test in accordance with ASTM E164 and AWS for 100 percent of all full penetration welds, braced and moment frame column splices, and a minimum of 20 percent of all other partial penetration column splices, at random.
- h. Welding Radiographic Testing: Test in accordance with ASTM E94, and AWS D1.1 for 5 percent of all full penetration welds at random.
- i. Verify that correction of rejected welds are made in accordance with D1.1.
- j. Testing and inspection do not relieve the Contractor of the responsibility Testing and inspection do not relieve the Contractor of the responsibility specified requirements.

2. Bolt Inspection:

- a. Inspect high-strength bolted connections in accordance AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts.
- b. Slip-Critical Connections: Inspect 10 percent of bolts, but not less than 2 bolts, selected at random in each connection in accordance with AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts. Inspect all bolts in connection when one or more are rejected.

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- c. Fully Pre-tensioned Connections: Inspect 10 percent of bolts, but not less than 2 bolts, selected at random in 25 percent of connections in accordance with AISC Specification for Structural Joints Using ASTM A325 or A490 Bolts. Inspect all bolts in connection when one or more are rejected.
  - d. Bolts installed by turn-of-nut tightening may be inspected with calibrated wrench when visual inspection was not performed during tightening.
  - e. Snug Tight Connections: Inspect 10 percent of connections verifying that plies of connected elements have been brought into snug contact.
  - f. Inspect field erected assemblies; verify locations of structural steel for plumbness, level, and alignment.
- D. Submit inspection reports, record of welders and their certification, and identification, and instances of noncompliance to RE/COTR.

**3.10 STEEL DECKING:**

- A. Provide field inspection of welds of metal deck to the supporting steel, and testing services to insure steel decking has been installed in accordance with contract documents and manufacturer's requirements.
- B. Qualification of Field Welding: Qualify welding processes and welding operators in accordance with "Welder Qualification" procedures of AWS D1.1. Refer to the "Plug Weld Qualification Procedure" in Part 3 "Field Quality Control."
- C. Submit inspection reports, certification, and instances of noncompliance to RE/COTR.

**3.11 SHEAR CONNECTOR STUDS:**

- A. Provide field inspection and testing services required by AWS D.1 to insure shear connector studs have been installed in accordance with contract documents.
- B. Tests: Test 20 percent of headed studs for fastening strength in accordance with AWS D1.1.
- C. Submit inspection reports, certification, and instances of noncompliance to RE/COTR.

**3.12 SPRAYED-ON FIREPROOFING:**

- A. Provide field inspection and testing services to certify sprayed-on fireproofing has been applied in accordance with contract documents.
- B. Obtain a copy of approved submittals from RE/COTR.
- C. Use approved installation in test areas as criteria for inspection of work.

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- D. Test sprayed-on fireproofing for thickness and density in accordance with ASTM E605.
1. Thickness gauge specified in ASTM E605 may be modified for pole extension so that overhead sprayed material can be reached from floor.
- E. Location of test areas for field tests as follows:
1. Thickness: Select one bay per floor, or one bay for each 930 m<sup>2</sup> (10,000 square feet) of floor area, whichever provides for greater number of tests. Take thickness determinations from each of following locations: Metal deck, beam, and column.
  2. Density: Take density determinations from each floor, or one test from each 930m<sup>2</sup> (10,000 square feet) of floor area, whichever provides for greater number of tests, from each of the following areas: Underside of metal deck, beam flanges, and beam web.
- F. Submit inspection reports, certification, and instances of noncompliance to RE/COTR.

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**SECTION 01 57 19**

**TEMPORARY ENVIRONMENTAL CONTROLS**

**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.



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**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. National Archives and Records Administration (NARA):
  - 1. 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 Resident Engineer and the Contracting Officer for Name(s) and qualifications of person(s) responsible for training the 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

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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 Work Area Plan showing the proposed activity in each portion of the 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.

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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. 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.
    - b. 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 Protect adjacent areas from despoilment by temporary excavations and 6.
  6. Manage borrow areas on and off Government property to minimize erosion and to prevent sediment from entering nearby water courses or lakes.
  7. Manage and control spoil areas on and off 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

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- 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. Protection of Fish and Wildlife Resources: Keep construction activities under surveillance, management, and control to minimize interference with, disturbance of, or damage to fish and wildlife. Prior to beginning construction operations, list species that require specific attention along with measures for their protection.
- 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 California, Bay Area Air Quality Management District (BAAQMD) Regulations 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 8:00 a.m. and 6:00p.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
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	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

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	
BACKHOES	75	CONCRETE PUMPS	75
DOZERS	75	CRANE	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	-
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 55 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.

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- 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, 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.

**1.2 RELATED WORK**

- A. Section 02 41 00, DEMOLITION.



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- B. Section 01 00 00, GENERAL REQUIREMENTS.
  - C. Lead Paint: Section 02 83 33.13, LEAD BASED PAINT REMOVAL AND DISPOSAL.

### 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 reuse and recycle new materials 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> provides a Construction Waste Management Database that Contractor shall provide on-site instructions and supervision of separation, handling, 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.

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- 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.

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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 Resident Engineer 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.

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- 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.
  - 1. U.S. Green Building Council (USGBC): LEED Green Building Rating System for New Construction

#### **1.7 RECORDS**

- A. 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 - EXECUTION**

#### **2.1 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.

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**2.2 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.

**2.3 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.

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**SECTION 02 41 00**

**DEMOLITION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

- A. This section specifies demolition and removal of buildings, portions of buildings, utilities, other structures and debris from trash dumps shown.

**1.2 RELATED WORK:**

- A. Demolition and removal of roads, walks, curbs, and on-grade slabs outside buildings to be demolished: Section 31 20 00, EARTH MOVING
- B. Safety Requirements: GENERAL CONDITIONS, Article, ACCIDENT PREVENTION.
- C. Disconnecting utility services prior to demolition: Section 01 00 00, GENERAL REQUIREMENTS.
- D. Reserved items that are to remain the property of the Government: Section 01 00 00, GENERAL REQUIREMENTS.
- E. Environmental Protection: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- F. Infectious Control: Section 01 00 00, GENERAL REQUIREMENTS, Article 1.7, INFECTION PREVENTION MEASURES.

**1.3 PROTECTION:**

- A. Perform demolition in such manner as to eliminate hazards to persons and property; to minimize interference with use of adjacent areas, utilities and structures or interruption of use of such utilities; and to provide free passage to and from such adjacent areas of structures. Comply with requirements of GENERAL CONDITIONS, Article, ACCIDENT PREVENTION.
- B. Provide safeguards, including warning signs, barricades, temporary fences, warning lights, and other similar items that are required for protection of all personnel during demolition and removal operations. Comply with requirements of Section 01 00 00, GENERAL REQUIREMENTS, Article 1.9 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES AND IMPROVEMENTS.
- C. Maintain fences, barricades, lights, and other similar items around exposed excavations until such excavations have been completely filled.
- D. Provide enclosed dust chutes with control gates from each floor to carry debris to truck beds and govern flow of material into truck. Provide overhead bridges of tight board or prefabricated metal construction at dust chutes to protect persons and property from falling debris.

- E. Prevent spread of flying particles and dust. Sprinkle rubbish and debris with water to keep dust to a minimum. Do not use water if it results in hazardous or objectionable condition such as, but not limited to; ice, flooding, or pollution. Vacuum and dust the work area daily.
  - F. In addition to previously listed fire and safety rules to be observed in performance of work, include following:
    - 1. No wall or part of wall shall be permitted to fall outwardly from structures.
    - 2. Wherever a cutting torch or other equipment that might cause a fire is used, provide and maintain fire extinguishers nearby ready for immediate use. Instruct all possible users in use of fire extinguishers.
    - 3. Keep hydrants clear and accessible at all times. Prohibit debris from accumulating within a radius of 4500 mm (15 feet) of fire hydrants.
  - G. Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The contractor shall take necessary precautions to avoid damages to existing items to remain in place, to be reused, or to remain the property of the Medical Center; any damaged items shall be repaired or replaced as approved by the Resident Engineer. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload structural elements. Provide new supports and reinforcement for existing construction weakened by demolition or removal works. Repairs, reinforcement, or structural replacement must have Resident Engineer's approval.
  - H. The work shall comply with the requirements of Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
  - I. The work shall comply with the requirements of Section 01 00 00, GENERAL REQUIREMENTS, Article 1.7 INFECTION PREVENTION MEASURES.
- 1.4 UTILITY SERVICES:**
- A. Demolish and remove outside utility service lines shown to be removed.
  - B. Remove abandoned outside utility lines that would interfere with installation of new utility lines and new construction.

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



**PART 3 - EXECUTION**

**3.1 DEMOLITION:**

- A. Completely demolish and remove buildings and structures, including all appurtenances related or connected thereto, as noted below:
  - 1. As required for installation of new utility service lines.
  - 2. To full depth within an area defined by hypothetical lines located 1500 mm (5 feet) outside building lines of new structures.
- B. Debris, including brick, concrete, stone, metals and similar materials shall become property of Contractor and shall be disposed of by him daily, off the Medical Center to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the Resident Engineer. Break up concrete slabs below grade that do not require removal from present location into pieces not exceeding 600 mm (24 inches) square to permit drainage. Contractor shall dispose debris in compliance with applicable federal, state or local permits, rules and/or regulations.
- C. In removing buildings and structures of more than two stories, demolish work story by story starting at highest level and progressing down to third floor level. Demolition of first and second stories may proceed simultaneously.
- D. Remove and legally dispose of all materials, other than earth to remain as part of project work, from any trash dumps shown. Materials removed shall become property of contractor and shall be disposed of in compliance with applicable federal, state or local permits, rules and/or regulations. All materials in the indicated trash dump areas, including above surrounding grade and extending to a depth of 1500mm (5feet) below surrounding grade, shall be included as part of the lump sum compensation for the work of this section. Materials that are located beneath the surface of the surrounding ground more than 1500 mm (5 feet), or materials that are discovered to be hazardous, shall be handled as unforeseen. The removal of hazardous material shall be referred to Hazardous Materials specifications.
- E. Remove existing utilities as indicated or uncovered by work and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the Resident Engineer. When Utility lines are encountered that are not indicated on the drawings, the Resident Engineer shall be notified prior to further work in that area.

**3.2 CLEAN-UP:**

On completion of work of this section and after removal of all debris, leave site in clean condition satisfactory to Resident Engineer. Clean-up shall include off the Medical Center disposal of all items and materials not required to remain property of the Government as well as all debris and rubbish resulting from demolition operations.

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**SECTION 03 30 00**

**CAST-IN-PLACE CONCRETE**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

- A. 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.
- B. Concrete roads, walks, and similar exterior site work: Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.

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

- A. Testing agency retained and reimbursed by the Contractor and approved by Resident Engineer.
- B. Testing agency maintaining active participation in Program of Cement and Concrete Reference Laboratory (CCRL) of National Institute of Standards and Technology. Accompany request for approval of testing agency with a copy of Report of Latest Inspection of Laboratory Facilities by CCRL.
- C. 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 mm (+0 inch) and -20 mm (-3/4 inch).
- B. Reinforcement Fabricating and Placing: ACI 117, except that fabrication tolerance for bar sizes Nos. 10, 13, and 16 (Nos. 3, 4, and 5) (Tolerance Symbol 1 in Fig. 2.1(a), ACI, 117) used as column ties or stirrups is +0 mm (+0 inch) and -13 mm (-1/2 inch) where gross bar length is less than 3600 mm (12 feet), or +0 mm (+0 inch) and -20 mm (-3/4 inch) where gross bar length is 3600 mm (12 feet) or more.
- C. Cross-Sectional Dimension: ACI 117, except tolerance for thickness of slabs 12 inches or less is +20 mm (+3/4 inch) and - 6 mm (-1/4 inch). Tolerance of thickness of beams more than 300 mm (12 inch) but less than 900 mm (3 feet) is +20 mm (+3/4 inch) and -10 mm (-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 600 mm (2 feet) of construction joints and vertical elements that project through slab surface.
2. Maximum elevation change which may occur within 600 mm (2 feet) of any column or wall element is 6 mm (0.25 inches).
3. Allow sample measurement lines that are perpendicular to construction joints to extend past joint into previous placement no further than 1500 mm (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. Samples:
  1. Portland cement: 3.5 kg (8 pounds).
  2. Fly ash: 2.25 kg (5 pounds).
- C. Shop Drawings: Reinforcing steel: Complete shop drawings. Comply with requirements of ACI SP-66. Include bar sizes, material types, lengths, spacings, locations, and quantities of reinforcing steel; bar schedules, stirrup spacing, shapes of bent bars, spacing of bars, and types and location of splices. Include special reinforcement required at openings and flat slab shear reinforcing. Do not reproduce construction documents for shop drawings.
- D. Shoring Drawings: All shoring and re-shoring drawings are to be prepared by, signed and sealed by a professional engineer registered in the State of California.
- E. Mill Test Reports:
  1. Reinforcing Steel.
  2. Cement.
- F. Manufacturer's Certificates:
  1. Cement.
  2. Aggregate.
  3. Lightweight aggregate for structural concrete.
  4. Air-entraining admixture.
  5. Chemical admixtures, including chloride ion content.

6. Waterproof paper for curing concrete.
  7. Liquid membrane-forming compounds for curing concrete.
  8. Non-shrinking grout.
  9. Liquid hardener.
  10. Waterstops.
  11. Expansion joint filler.
  12. Adhesive binder.
  13. Color Pigments.
  14. Vapor Barrier
- G. G. Product Data:
1. Mechanical Couplers
  2. Headed Reinforcement
- H. 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 and copy of report of latest CCRL, Inspection of Laboratory.
- I. Concrete Mix Design: Submit for each type and strength of concrete.
1. Include unit weight, slump, water-cement fly ash ratio curves, concrete mix ingredients, admixtures and compression test reports. Results of testing or test data used to establish mix proportions are to be provided for each mix design. Include shrinkage test data for mix designs.
  2. Mix designs to be prepared, stamped and signed by a Professional Engineer registered in the State of California.
- J. Construction joints: Submit plans showing proposed construction joint locations. The maximum spacing of joints is to be as indicated in the typical details.
- 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 300 mm (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.

- D. Store reinforcement in a manner that will prevent rusting or coating with grease, oil, dirt, and other objectionable material.
- E. Deliver reinforcement to the job site bundled, tagged and marked using metal tags.

**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; Resident Engineer; Consulting Engineer; Department of Veterans Affairs retained testing laboratories for concrete testing and finish (F-number) verification.
- 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):
  - 117-06..... Tolerances for Concrete Construction and  
Materials
  - 211.1-02..... Selecting Proportions for Normal, Heavyweight,  
and Mass Concrete
  - 211.2-04..... Selecting Proportions for Structural Lightweight  
Concrete
  - 214R-02..... Evaluation of Strength Test Results of Concrete
  - 301-05..... Structural Concrete

- 304R-2000..... Guide for Measuring, Mixing, Transporting, and  
Placing Concrete
- 305R-06..... Hot Weather Concreting
- 306R-(2002)..... Cold Weather Concreting
- 308R-(2001)..... Standard Practice for Curing Concrete
- 309R-05..... Guide for Consolidation of Concrete
- 318-08..... Building Code Requirements for Reinforced  
Concrete and Commentary
- 347R-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..... Steel Wire, Plain, for Concrete Reinforcement  
A185/185M-07..... Steel Welded Wire Fabric, Plain, for Concrete  
Reinforcement  
A615/A615M-08..... Deformed and Plain Billet-Steel Bars for Concrete  
Reinforcement  
A653/A653M-07..... Steel Sheet, Zinc-Coated (Galvanized) or  
Zinc-Iron Alloy-Coated (Galvannealed) by the  
Hot-Dip Process  
A706/A706M-06..... Low-Alloy Steel Deformed and Plain Bars for  
Concrete Reinforcement  
A767/A767M-05..... Zinc-Coated (Galvanized) Steel Bars for Concrete  
Reinforcement  
A775/A775M-07..... Epoxy-Coated Reinforcing Steel Bars  
A820-06..... Steel Fibers for Fiber-Reinforced Concrete  
A996/A996M-06..... Rail-Steel and Axle-Steel Deformed Bars for  
Concrete Reinforcement  
C31/C31M-08..... Making and Curing Concrete Test Specimens in the  
field  
C33-07..... Concrete Aggregates  
C39/C39M-05..... Compressive Strength of Cylindrical Concrete  
Specimens  
C94/C94M-07..... Ready-Mixed Concrete

C143/C143M-05..... Slump of Hydraulic Cement Concrete  
C150-07..... Portland Cement  
C171-07..... Sheet Materials for Curing Concrete  
C172-07..... Sampling Freshly Mixed Concrete  
C173-07..... Air Content of Freshly Mixed Concrete by the  
Volumetric Method  
C192/C192M-07..... Making and Curing Concrete Test Specimens in the  
Laboratory  
C231-08..... Air Content of Freshly Mixed Concrete by the  
Pressure Method  
C260-06..... Air-Entraining Admixtures for Concrete  
C309-07..... Liquid Membrane-Forming Compounds for Curing  
Concrete  
C330-05..... Lightweight Aggregates for Structural Concrete  
C494/C494M-08..... Chemical Admixtures for Concrete  
C496-06..... Splitting Tensile Strength of Cylindrical  
Concrete Specimens  
C567-05..... Density of Structural Lightweight Concrete  
C618-05..... Coal Fly Ash and Raw or Calcined Natural Pozzolan  
for Use as a Mineral Admixture in Concrete  
C666/C666M-03..... Resistance of Concrete to Rapid Freezing and  
Thawing  
C881/C881M-02..... Epoxy-Resin-Base Bonding Systems for Concrete  
C1107/1107M-07..... Packaged Dry, Hydraulic-Cement Grout (Non-shrink)  
D6-95 (R2006)..... Loss on Heating of Oil and Asphaltic Compounds  
D297-93 (R2006)..... Rubber Products-Chemical Analysis  
D1751-04..... Preformed Expansion Joint Filler for Concrete  
Paving and Structural Construction (Non-extruding  
and Resilient Bituminous Types)  
D4397-02..... Polyethylene Sheeting for Construction,  
Industrial and Agricultural Applications  
E1155-96 (R2008)..... Determining  $F_F$  Floor Flatness and  $F_L$  Floor  
Levelness Numbers

E. American Welding Society (AWS):

D1.4-05..... 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) 16 mm (5/8 inch), or 20 mm (3/4 inch) thick for unlined contact form. B-B High Density Concrete Form Overlay optional.
  
- C. 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 48 kPa (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.
  
- D. Form Lining:
  - 1. 1. Hardboard: ANSI/AHA A135.4, Class 2 with one (S1S) smooth side)
  - 2. 2. Plywood: Grade B-B Exterior (concrete-form) not less than 6 mm (1/4 inch) thick.
  - 3. 3. Plastic, fiberglass, or elastomeric capable of reproducing the desired pattern or texture.
  
- E. Form Ties: Develop a minimum working strength of 13.35 kN (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 20 mm (3/4 inch) diameter, or a depression in exposed concrete surface, or leave metal closer than 40 mm (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. Acquire all cement for entire project from the same source.
- 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 300 mm (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.
  - 4. Acquire all aggregates for entire project from the same source.
  - 5. Cleanliness not to be less than 75 when tested in accordance with California Test 227.
- D. Lightweight Aggregates for Structural Concrete: ASTM C330, Table 1. Maximum size of aggregate not larger than one-fifth of narrowest dimension between forms, nor three-fourth of minimum clear distance between reinforcing bars. Contractor to furnish certified report to verify that aggregate is sound and durable, and has a durability factor of not less than 80 based on 300 cycles of freezing and thawing when tested in accordance with ASTM C666.
  - 1. Course aggregate to be rotary kiln-expanded shale or clay having surface scaled by firing.
  - 2. Fine aggregate to be a blend of natural sand and lightweight fines.
- E. Fine Aggregate: ASTM C33. Fine aggregate for applied concrete floor topping shall pass a 4.75 mm (No. 4) sieve, 10 percent maximum shall pass a 150  $\mu$ m (No. 100) sieve.
  - 1. Acquire all aggregates for entire project from the same source.
  - 2. Cleanliness not to be less than 75 when tested in accordance with California Test 217.
- F. Mixing Water: Fresh, clean, and potable.
- G. 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. Calcium Nitrite corrosion inhibitor: ASTM C494 Type C.
  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.
- H. Vapor Barrier: ASTM E1745, Class A, 0.25 mm (10 mil) or greater.
1. Multi-layer plastic extrusion or equivalent, stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs.
  2. Vapor transmission rate to be 0.008 WVTR or lower per ASTM E 96.
  3. Single ply polyethylene is prohibited.
- I. Reinforcing Steel, #7 bars and smaller: ASTM A615, deformed, grade as indicated on drawings.
- J. Reinforcing Steel, #8 and larger and all bars to be welded: ASTM A706, deformed, grade as indicated on drawings. Permitted for bars #7 and smaller.
- K. Welded Wire Fabric: ASTM A185.
- L. Galvanized Reinforcing Bars: ASTM A767.
- M. Epoxy Coated Reinforcing Bars: ASTM A775.
- N. Cold Drawn Steel Wire: ASTM A82.
- O. Reinforcement for Metal Pan Stair Fill: 50 mm (2 inch) wire mesh, either hexagonal mesh at .8Kg/m<sup>2</sup> (1.5 pounds per square yard), or square mesh at .6Kg/m<sup>2</sup> (1.17 pounds per square yard).
- P. Supports, Spacers, and Chairs: Types which will hold reinforcement in position shown in accordance with requirements of ACI 318 except as specified.
- Q. Expansion Joint Filler: ASTM D1751.
- R. Sheet Materials for Curing Concrete: ASTM C171.
- S. Liquid Membrane-forming Compounds for Curing Concrete: ASTM C309, Type I, with fugitive dye. Compound shall be compatible with scheduled surface treatment, such as paint and resilient tile, flooring adhesives, and shall not discolor concrete surface.

- T. Abrasive Aggregate: Aluminum oxide grains or emery grits.
- U. Liquid Hardener and Dustproofer: Fluosilicate solution of magnesium fluosilicate or zinc fluosilicate. Magnesium and zinc may be used separately or in combination as recommended by manufacturer.
- V. Liquid Densifier/Sealer: 100% active colorless aqueous silicate solution.
- W. Penetrating Sealer: For use on parking garage ramps and decks. High penetration silane sealer providing minimum 95 percent screening per National Cooperative Highway Research Program (NCHRP) No. 244 standards for chloride ion penetration resistance. Requires moist (non-membrane) curing of slab.
- X. Non-Shrink Grout:
  - 1. ASTM C1107, pre-mixed, produce a compressive strength of at least 18 MPa at three days and 48 MPa (7000 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 1200 mm x 1200 mm (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 450 mm x 900 mm (18 inch by 36 inch) base plate.
- Y. Adhesive Binder: ASTM C881.
- Z. Polyvinyl Chloride Waterstop: CRD C572.
- AA. Rubber Waterstops: CRD C513.
- BB. Bentonite Water Stop: Flexible strip of bentonite 25 mm x 20 mm (1 inch by 3/4 inch), weighing 8.7 kg/m (5.85 lbs. per foot) composed of Butyl Rubber Hydrocarbon (ASTM D297), Bentonite (SS-S-210-A) and Volatile Matter (ASTM D6).
- CC. Porous Backfill: Crushed stone or gravel graded from 25 mm to 20 mm (1 inch to 3/4 inch).
- DD. Synthetic Fibers: Monofilament or fibrillated polypropylene fibers for secondary reinforcing of concrete members. Use appropriate length and 0.9 kg/m<sup>3</sup> (1.5 lb. per cubic yard). Product shall have a UL rating.
- EE. Steel Fibers: ASTM A820, Type I cold drawn, high tensile steel wire for use as primary reinforcing in slab-on-grade. Minimum dosage rate 18 kg/m<sup>3</sup> (30 lb. per cubic yard).
- FF. Epoxy Joint Filler: Two component, 100 percent solids compound, with a minimum shore D hardness of 50.
- GG. Bonding Admixture: Non-rewettable, polymer modified, bonding compound.

- HH. Architectural Concrete: For areas designated as architectural concrete on the Contract Documents, use colored cements and specially selected aggregates as necessary to produce a concrete of a color and finish which exactly matches the designated sample panel. See Section 03 33 00 ARCHITECTURAL CONCRETE.
- II. Reinforcing Steel Mechanical Couplers: Classified as Type 2 Mechanical Couplers per ACI 318. Coupler to be capable of developing 100 percent of the specified tensile strength of the steel and, in tension and compression, at least 125 percent of the specified yield strength (Fy) of the bar. Coupler to have a current ICC-ES report classifying the coupler as Type 2 per ACI. Couplers are to be of the type are threaded or welded to the ends of the reinforcing bars. Couplers utilizing bolts to attach the coupler to the reinforcing bar are not acceptable.1.
- JJ. Headed and Mechanically Anchored Reinforcement: Headed and mechanically anchored deformed reinforcement is to comply with the provisions of ACI 318, Section 12.6. Products are to be capable of developing the full yield strength of the bar in tension and are to have a current ICC-ES report showing compliance with ACI.
- KK. Shrinkage Reducing Admixture: ASTM C494/C 494M, ASTM C 157

### 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. Include dry unit weight of lightweight structural concrete.
  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 specifications initially with mix design and for each truck load of fly ash delivered from source. Notify Resident Engineer immediately when change in source is anticipated. Prior to beginning trial mixes submit to the Resident Engineer the following representative samples of material to be used, properly identified source and project description and number, type of testing (complete chemical and physical), suitably packaged for shipment, and addressed as specified. Allow 60 calendar days for test results after submittal of sample.

1. Fly ash - 2.25 kg (five pounds).
  2. Portland cement - 3.5 kg (8 pounds):
    - a. Address -Waterways Experiment Station (WES)
    - b. 3909 Halls Ferry Road
    - c. Vicksburg, MS 39180-6199
    - d. ATTN: Engineering Materials Group
- 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 Resident Engineer 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. Resident Engineer 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. Fly ash may be substituted for up to 50 percent of the minimum cement factor at option of Contractor, except fly ash may not be used in concrete designated as architectural concrete.

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

Concrete Strength		Non-Air-Entrained	Air-Entrained	
Min. 28 Day Comp. Str. MPa (psi)	Min. Cement kg/m <sup>3</sup> (lbs/c. yd)	Max. Water Cement Ratio	Min. Cement kg/m <sup>3</sup> (lbs/c. yd)	Max. Water Cement Ratio
30 (4000) <sup>1,3</sup>	325 (550)	0.45	340 (570)	0.40

1. If trial mixes are used, the proposed mix design shall achieve a compressive strength 8.3 MPa (1200 psi) in excess of f'c. For concrete strengths above 35 Mpa (5000 psi), the proposed mix design shall achieve a compressive strength 9.7 MPa (1400 psi) in excess of f'c.
  2. Lightweight Structural Concrete. Pump mixes may require higher cement values.
  3. For concrete exposed to high sulfate content soils maximum water cement ratio is 0.44.  
 \*Determined by Laboratory in accordance with ACI 211.1 for normal concrete or ACI 211.2 for lightweight structural concrete.
- 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	Lightweight Structural Concrete
Reinforced Footings and Substructure Walls	75mm (3 inches)	75 mm (3 inches)
Slabs, Beams, Reinforced Walls, and Building Columns	100 mm (4 inches)	100 mm (4 inches)

\*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 225 mm (9 inches). The concrete shall arrive at the job site at a slump of 50 mm to 75 mm (2 inches to 3 inches), and 75 mm to 100 mm (3 inches to 4 inches) for lightweight concrete. This should be verified, and then the high-range-water-reducing admixture added to increase the slump to the approved level.

- F. 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
10 mm (3/8 in).6 to 10	13 mm (1/2 in).5 to 9
20 mm (3/4 in).4 to 8	25 mm (1 in).3-1/2 to 6-1/2
40 mm (1 1/2 in).3 to 6	

**TABLE IV  
 AIR CONTENT OF LIGHTWEIGHT STRUCTURAL CONCRETE**

Nominal Maximum size of Total Air Content	Coarse Aggregate, mm's (Inches) Percentage by Volume
Greater than 10 mm (3/8 in) 4 to 8	10 mm (3/8 in) or less 5 to 9

- G. Drying Shrinkage: Test per ASTM C192 and ASTM C157.
1. Typical: Maximum 0.050 percent unless otherwise indicated.
  2. Slabs-on-grade and Suspended Slabs: Maximum 0.045 percent.
  3. Shrinkage Reducing Admixture: Provide as required to obtain drying shrinkage when adequate shrinkage data for concrete mix design is not available.

- 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. Lightweight structural concrete shall not weigh more than air-dry unit weight of 115 pounds per cubic foot. Air-dry unit weight determined on 150 mm by 300 mm (6 inch by 12 inch) test cylinders after seven days standard moist curing followed by 21 days drying at 23 degrees C  $\pm$  1.7 degrees C (73.4  $\pm$  3 degrees Fahrenheit), and 50 (plus or minus 7) percent relative humidity. Use wet unit weight of fresh concrete as basis of control in field.
- J. 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).
- K. Durability: Use air entrainment for exterior exposed concrete subjected to freezing and thawing and other concrete shown or specified. Air content as shown in Table III or Table IV.
- L. 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 3.5 MPa (500 psi) below specified strength. Interpret field test results in accordance with ACI 214. Should strengths shown by test specimens fall below required values, Resident Engineer 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, Resident Engineer 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, Resident Engineer 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 Resident Engineer.



## 2.4 BATCHING AND MIXING:

- A. General: Concrete shall be "Ready-Mixed" and comply with ACI 318 and ASTM C94, except as specified. Batch mixing at the site is permitted. Mixing process and equipment must be approved by Resident Engineer. 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 38°C (100 degrees Fahrenheit). Minimum delivery temperature as follows:

Atmospheric Temperature	Minimum Concrete Temperature
-1. degrees to 4.4 degrees C (30 degrees to 40 degrees F)	15.6 degrees C (60 degrees F.)
-17 degrees C to -1.1 degrees C (0 degrees to 30 degrees F.)	21 degrees C (70 degrees F.)

1. Services of aggregate manufacturer's representative shall be furnished during the design of trial mixes and as requested by the Resident Engineer 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 Resident Engineer.

## PART 3 - EXECUTION

### 3.1 FORMWORK:

- A. General: Design in accordance with ACI 347 is the responsibility of the Contractor. The Contractor shall retain a registered Professional Engineer to design the formwork, shores, and reshores.
1. Form boards and plywood forms may be reused for contact surfaces of exposed concrete only if thoroughly cleaned, patched, and repaired and Resident Engineer approves their reuse.
  2. Provide forms for concrete footings unless Resident Engineer determines forms are not necessary.
  3. Corrugated fiberboard forms: Place forms on a smooth firm bed, set tight, with no buckled cartons to prevent horizontal displacement, and in a dry condition when concrete is placed.
- 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 150 mm (6 inches) apart.
- E. Lined Forms: May be used in lieu of unlined plywood forms. Back up form lining solidly with square edge board lumber securely nailed to studs with all edges in close contact to prevent bulging of lining. No joints in lining and backing may coincide. Nail abutted edges of sheets to same backing board. Nail lining at not over 200 mm (8 inches) on center along edges and with at least one nail to each square foot of surface area; nails to be 3d blued shingle or similar nails with thin flatheads.
- F. Architectural Liner: Attach liner as recommended by the manufacturer with tight joints to prevent leakage.
- G. 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 150 mm (6 inches) above each construction joint. Space through-ties adjacent to horizontal and vertical construction joints not over 450 mm (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.
- H. Inserts, Sleeves, and Similar Items: Flashing reglets, steel strips, masonry ties, anchors, wood blocks, nailing strips, grounds, inserts, wire hangers, sleeves, drains, guard angles, forms for floor hinge boxes, 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. Locate inserts or hanger wires for furred and suspended ceilings only in bottom of concrete joists, or similar concrete member of overhead concrete joist construction.

2. 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.
3. Do not install sleeves in beams, joists or columns except where shown or permitted by Resident Engineer. Install sleeves in beams, joists, or columns that are not shown, but are permitted by the Resident Engineer, and require no structural changes, at no additional cost to the Government.
4. 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.
5. Provide recesses and blockouts in floor slabs for door closers and other hardware as necessary in accordance with manufacturer's instructions.

I. 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 and ACI 315, 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 1.6 mm (16 gauge) black annealed wire. Use epoxy-coated tie wire with epoxy-coated reinforcing. 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 315. 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.
  2. Lap welded wire fabric at least 1 1/2 mesh panels plus end extension of wires not less than 300 mm (12 inches) in structural slabs. Lap

welded wire fabric at least 1/2 mesh panels plus end extension of wires not less than 150 mm (6 inches) in slabs on grade.

- 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, unless otherwise noted on drawings.
- 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 36 (Number 11). Minimum lengths of lap as shown.
  2. Welded splices: Splicing by butt-welding of reinforcement permitted providing the weld develops in tension at least 125 percent of the yield strength ( $f_y$ ) for the bars. Welding conform to the requirements of AWS D1.4. Welded reinforcing steel conform to the chemical analysis requirements of AWS D1.4.
    - a. Submit test reports indicating the chemical analysis to establish weldability of reinforcing steel.
    - b. Submit a field quality control procedure to insure proper inspection, materials and welding procedure for welded splices.
    - c. Department of Veterans Affairs retained testing agency shall test a minimum of three splices, for compliance, locations selected by Resident Engineer.
  3. Mechanical Splices: Develop 100 percent of the specified tensile strength and, 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 Resident Engineer, 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 when approved by Resident Engineer.
- 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.
- G. Future Bonding: Protect exposed reinforcement bars intended for bonding with future work by wrapping with felt and coating felt with a bituminous compound unless otherwise shown.

**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. Vapor barrier joints lapped 150 mm (6 inches) and sealed with compatible waterproof pressure-sensitive tape.
  - 2. Patch punctures and tears.

**3.4 CONSTRUCTION JOINTS:**

- A. Unless otherwise shown, location of construction joints to limit individual placement shall not exceed 24,000 mm (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 Resident Engineer.
- 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.
- E. Install polyvinyl chloride or rubber water seals, as shown in accordance with manufacturer's instructions, to form continuous watertight seal.

**3.5 EXPANSION JOINTS:**

- A. Clean expansion joint surfaces before installing premolded filler and placing adjacent concrete.
- B. Install polyvinyl chloride or rubber water seals, as shown in accordance with manufacturer's instructions, to form continuous watertight seal.

**3.6 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 Resident Engineer 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. Roughen surfaces to 1/4 inch minimum amplitude by heavy sand-blasting, waterblasting or bush-hammering.
  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 subject to approval of Resident Engineer.
- 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 it's 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.

**3.7 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 Resident Engineer.

**3.8 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 Resident Engineer.

**3.9 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 Resident Engineer.

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.

### **3.10 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.

### **3.11 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.

### 3.12 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 Resident Engineer, 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 m<sup>2</sup> (2 square feet) in each 93 m<sup>2</sup> (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 Resident Engineer 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 Resident Engineer 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 Resident Engineer from sample panel.
11. Finished slab flatness (FF) and levelness (FL) values comply with the following minimum requirements:
  - a. Areas covered with carpeting, or not specified otherwise in b. below:

Slab on Grade:

Specified overall value	F <sub>F</sub> 25/F <sub>L</sub> 20
Minimum local value	F <sub>F</sub> 17/F <sub>L</sub> 15

Level suspended slabs (shored until after testing) and topping slabs:

Specified overall value	FF 25/FL 20
Minimum local value	FF 17/FL 15

Unshored suspended slabs:

Specified overall value	FF 25
Minimum local value	FF 17

Level tolerance such that 80 percent of all points fall within a 20 mm (3/4 inch) envelope +10 mm, -10 mm (+3/8 inch, -3/8 inch) from the design elevation.
  - b. Areas that will be exposed, receive thin-set tile or resilient flooring, or roof areas designed as future floors:

Slab on grade:

Specified overall value	FF 36/FL 20
Minimum local value	FF 24/FL 15

Level suspended slabs (shored until after testing) and topping slabs

Specified overall value	FF 30/FL 20
Minimum local value	FF 24/FL 15

Unshored suspended slabs:

Specified overall value	FF 30
Minimum local value	FF 24

Level tolerance such that 80 percent of all points fall within a 20 mm (3/4 inch) envelope +10 mm, -10 mm (+3/8 inch, -3/8 inch) from the design elevation.

- c. "Specified overall value" is based on the composite of all measured values in a placement derived in accordance with ASTM E1155.
- d. "Minimum local value" (MLV) describes the flatness or levelness below which repair or replacement is required. MLV is based on the results of an individual placement and applies to a minimum local area. Minimum local area boundaries may not cross a construction joint or expansion joint. A minimum local area will be bounded by construction and/or control joints, or by column lines and/or half-column lines, whichever is smaller.

12. Measurements

- a. Department of Veterans Affairs retained testing laboratory will take measurements as directed by Resident Engineer, to verify compliance with  $F_F$ ,  $F_L$ , and other finish requirements. Measurements will occur within 72 hours after completion of concrete placement (weekends and holidays excluded). Make measurements before shores or forms are removed to insure the "as-built" levelness is accurately assessed. Profile data for above characteristics may be collected using a laser level or any Type II apparatus (ASTM E1155, "profileograph" or "dipstick"). Contractor's surveyor shall establish reference elevations to be used by Department of Veterans Affairs retained testing laboratory.
- b. Contractor not experienced in using  $F_F$  and  $F_L$  criteria is encouraged to retain the services of a floor consultant to assist with recommendations concerning adjustments to slab thicknesses, finishing techniques, and procedures on measurements of the finish as it progresses in order to achieve the specific flatness and levelness numbers.

13. Acceptance/ Rejection:

- a. If individual slab section measures less than either of specified minimum local  $F_F/F_L$  numbers, that section shall be rejected and remedial measures shall be required. Sectional boundaries may be set at construction and contraction (control) joints, and not smaller than one-half bay.
- b. If composite value of entire slab installation, combination of all local results, measures less than either of specified overall  $F_F/F_L$  numbers, then whole slab shall be rejected and remedial measures shall be required.

14. 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 Resident Engineer, until a slab finish constructed within specified tolerances is accepted.

**3.13 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.

**3.14 APPLIED TOPPING:**

- A. Separate concrete topping on floor base slab of thickness and strength shown. Topping mix shall have a maximum slump of 200 mm (8 inches) for concrete containing a high-range water-reducing admixture (superplasticizer) and 100 mm (4 inches) for conventional mix. Neatly bevel or slope at door openings and at slabs adjoining spaces not receiving an applied finish.
- B. Placing: Place continuously until entire section is complete, struck off with straightedge, leveled with a highway straightedge or highway bull float, floated and troweled by machine to a hard dense finish. Slope to floor drains as required. Do not start floating until free water has disappeared and no water sheen is visible. Allow drying of surface moisture naturally. Do not hasten by "dusting" with cement or sand.

**3.15 RETAINING WALLS:**

- A. Use air-entrained concrete.
- B. Expansion and contraction joints, waterstops, weep holes, reinforcement and railing sleeves installed and constructed as shown.
- C. Exposed surfaces finished to match adjacent concrete surfaces, new or existing.
- D. Place porous backfill as shown.

- - - E N D - - -



**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. Support for Wall and Ceiling Mounted Items
  - 2. Guards
  - 3. Covers and Frames for Pits and Trenches
  - 4. Gratings
  - 5. Gas Racks
  - 6. Plate Door Sill
  - 7. Safety Nosings
  - 8. Ladders
  - 9. Railings
  - 10. Glazed-decorative guard railings. (ASI#043)
  - 11. Balcony glass guard. (ASI#043)
  - ~~10.~~12. Catwalks and Platforms
  - ~~11.~~13. Sidewalk Access Doors
  - ~~12.~~14. Steel Counter or Bench Top Frame and Leg
  - ~~13.~~15. Three dimensional, welded wire trellising system

**1.2 RELATED WORK**

- A. Railings attached to steel stairs: Section 05 51 00, METAL STAIRS.
- B. Ornamental railings attached decorative metal stairs: Section 05 71 00, DECORATIVE METAL STAIRS.
- C. Colors, finishes, and textures: Section 09 06 00, SCHEDULE FOR FINISHES.
- D. Prime and finish painting: Section 09 91 00, PAINTING.
- E. Stainless steel corner guards: Section 10 26 00, WALL AND DOOR PROTECTION.

### 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. Grating, each type.
  - 2. Manhole covers.
  - 3. Floor plate.
  - 4. Sidewalk access door.
  - 5. Safety nosing.
  - 6. Aluminum grating for mechanical screen wall.
  - 7. Ornamental railing point-supported glass hardware.
  - 8. Stainless steel handrail.
- 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.
  - 4. Drawings shall be stamped and signed by a professional engineer licensed in the state of California. (ASI#043)
- D. Manufacturer's Certificates:
  - 1. Anodized finish as specified.
  - 2. Live load designs as specified.
- E. Structural Design Calculations for specified live loads including dead loads shall be stamped and signed by a professional engineer licensed in the state of California. (ASI#043)
- F. 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):
1. B18.6.1-81(R1997) Wood Screws
  2. B18.2.2-87(R2005) Square and Hex Nuts
- C. American Society for Testing and Materials (ASTM):
1. A36/A36M-05 Structural Steel
  2. A47-99(R2004) Malleable Iron Castings
  3. A48-03 Gray Iron Castings
  4. A53-06 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
  5. A123-02 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
  6. A167-99(R2004) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip
  7. A269-07 Seamless and Welded Austenitic Stainless Steel Tubing for General Service
  8. A307-07 Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
  9. A312/A312M-06 Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
  10. A391/A391M-01 Grade 80 Alloy Steel Chain
  11. A653/A653M-07 Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process
  12. A786/A786M-05 Rolled Steel Floor Plate
  13. B221-06 Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
  14. B456-03 Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium
  15. B632-02 Aluminum-Alloy Rolled Tread Plate
  16. C1107-07 Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
  17. D3656-04 Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns
  18. F436-07 Hardened Steel Washers

- 19. F468-06 Nonferrous Bolts, Hex Cap Screws, and Studs for General Use
  - 20. F593-02 Stainless Steel Bolts, Hex Cap Screws, and Studs
  - 21. F1667-05 Driven Fasteners: Nails, Spikes and Staples
- D. American Welding Society (AWS):
- 1. D1.1-04 Structural Welding Code Steel
  - 2. D1.2-03 Structural Welding Code Aluminum
  - 3. D1.3-98 Structural Welding Code Sheet Steel
- E. National Association of Architectural Metal Manufacturers (NAAMM)
- 1. AMP521-01 Pipe Railing Manual
  - 2. AMP 500-505-1988 Metal Finishes Manual
  - 3. MBG 531-00 Metal Bar Grating Manual
  - 4. MBG 532-00 Heavy Duty Metal Bar Grating Manual
- F. Structural Steel Painting Council (SSPC):
- 1. SP 1-05 No. 1, Solvent Cleaning
  - 2. SP 2-05 No. 2, Hand Tool Cleaning
  - 3. SP 3-05 No. 3, Power Tool Cleaning
- G. Federal Specifications (Fed. Spec):
- 1. 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. Ladders and Rungs: 120 kg (250 pounds) at any point.
- C. Railings and Handrails: 900 N (200 pounds) in any direction at any point.
- D. Gratings, Covers, Catwalks, : 500 kg/m<sup>2</sup> (100 pounds per square foot). 1200 kg/m<sup>2</sup> (250 pounds per square foot) for vehicle loads.
- E. Manhole Covers: 1200 kg/m<sup>2</sup> (250 pounds per square foot).

### **2.2 MATERIALS**

- A. Structural Steel, Steel Plates, Shapes, and Bars : ASTM A36.
- B. Stainless Steel: ASTM A167, Type 302 or 304.

- C. Aluminum, Extruded: ASTM B221, Alloy 6063-T5 unless otherwise specified. For structural shapes use alloy 6061-T6 and alloy 6061-T4511.
- D. Floor Plate:
  - 1. Steel ASTM A786.
  - 2. Aluminum: ASTM B632.
- E. Steel Pipe: ASTM A53.
  - 1. Galvanized for exterior locations.
  - 2. Type S, Grade A unless specified otherwise.
  - 3. NPS (inside diameter) as shown.
- F. Cast-Iron: ASTM A48, Class 30, commercial pattern.
- G. Malleable Iron Castings: A47.
- H. Primer Paint: As specified in Section 09 91 00, PAINTING.
- I. Stainless Steel Tubing: ASTM A269, type 302 or 304.
- J. Modular Channel Units:
  - 1. Factory fabricated, channel shaped, cold formed sheet steel shapes, complete with fittings bolts and nuts required for assembly.
  - 2. Form channel within turned pyramid shaped clamping ridges on each side.
  - 3. Provide case hardened steel nuts with serrated grooves in the top edges designed to be inserted in the channel at any point and be given a quarter turn so as to engage the channel clamping ridges. Provide each nut with a spring designed to hold the nut in place.
  - 4. Factory finish channels and parts with oven baked primer when exposed to view. Channels fabricated of ASTM A525, G90 galvanized steel may have primer omitted in concealed locations. Finish screws and nuts with zinc coating.
  - 5. Fabricate snap-in closure plates to fit and close exposed channel openings of not more than 0.3 mm (0.0125 inch) thick stainless steel.
- K. 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 (1 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 Metal Finishes Manual.
2. Aluminum: NAAMM AMP 501.
  - a. Mill finish, AA-M10, as fabricated, use unless specified otherwise.
  - b. Clear anodic coating, AA-C22A41, chemically etched medium matte, with Architectural Class 1, 0.7 mils or thicker.
  - c. Painted: AA-C22R10.
3. 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.
- 4. Stainless Steel: NAAMM AMP-504 Finish No. 4.
  - 5. Chromium Plating: ASTM B456, satin or bright as specified, Service Condition No. SC2.

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.

B. For Ceiling Hung Toilet Stall:

- 1. Use a continuous steel channel above pilasters with hangers centered over pilasters.
- 2. Make provision for installation of stud bolts in lower flange of channel.
- 3. Provide a continuous steel angle at wall and channel braces spaced as shown.
- 4. Use threaded rod hangers.
- 5. Provide diagonal angle brace where the suspended ceiling over toilet stalls does not extend to side wall of room.
- 6. Provide supports for ceiling hung pilasters at dressing booths and entrance screen to toilet room similar to support for toilet stall pilasters.

C. For Wall Mounted Items:

- 1. For items supported by metal stud partitions.
- 2. Steel strip or hat channel minimum of 1.5 mm (0.0598 inch) thick.

3. Steel strip minimum of 150 mm (6 inches) wide, length extending one stud space beyond end of item supported.
4. Steel hat channels where shown. Flange cut and flatted for anchorage to stud.
5. Structural steel tube or channel for grab bar at water closets floor to structure above with clip angles or end plates formed for anchors.
6. Use steel angles for thru wall counters. Drill angle for fasteners at ends and not over 100 mm (4 inches) on center between ends.

D. For Trapeze Bars:

1. Construct assembly above ceilings as shown and design to support not less than a 340 kg (750 pound) working load at any point.
2. Fabricate trapeze supports as shown, with all exposed members, including screws, nuts, bolts and washers, fabricated of stainless steel.
3. Fabricate concealed components of structural steel shapes unless shown otherwise.
4. Stainless steel ceiling plate drilled for eye bolt.
5. Continuously weld connections where welds shown.
6. Use modular channel where shown with manufacturers bolts and fittings.
  - a. Weld ends of steel angle braces to steel plates and secure to modular channel units as shown. Drill plates for anchor bolts.
  - b. Fabricate eye bolt, special clamp bolt, and plate closure full length of modular channel at ceiling line and secure to modular channel unit with manufacturers standard fittings.

E. For Cubicle Curtain Track:

1. Fabricate assembly of steel angle as shown.
2. Drill angle bent ends for anchor screws to acoustical suspension system and angle for hanger wires.
3. Provide pipe sleeve welded to angle.

F. Supports for Exercise Equipment, and Items at Various Conditions at Suspended Ceilings:

1. Fabricate of structural steel shapes as shown.
2. Drill for anchor bolts of suspended item.

## 2.6 GUARDS

A. Channel Guard at Loading Platform:

1. Fabricate from steel channel of size shown.
2. Weld anchors to channels as shown.
3. Drill channel for bumper anchor bolts.

B. Edge Guard Angles for Openings in slabs.



1. Fabricate from steel angles of sizes and with anchorage shown.
2. Where size of angle is not shown, provide 50 x 50 x 6 mm (2 x 2 x 1/4 inch) steel angle with 32 x 5 mm (1-1/4 x 3/16 inch) strap anchors, welded to back.
3. Miter or butt angles at corners and weld.
4. Use one anchor near end and three feet on centers between end anchors.

## **2.7 COVERS AND FRAMES FOR PITS AND TRENCHES**

- A. Fabricate covers to support live loads specified.
- 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 smooth 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. Fabricate trench cover sections not be over 900 mm (3 feet) long and if width of trench is more than 900 mm (3 feet) or over, equip one end of each section with an angle or "T" bar stiffener to support adjoining plate.
  7. Use two, 13 mm (1/2 inch) diameter steel bar flush drop handles for each cover section.
- D. Cast Iron Covers
  1. Fabricate covers to support live loads specified.
  2. Fabricate from ASTM A48, cast-iron, 13 mm (1/2 inch) minimum metal thickness, cast with stiffeners as required.
  3. Fabricate as flush type with frame, reasonably watertight and be equipped with flush type lifting rings. Provide seals where watertight covers noted.
  4. Make covers in sections not over 90 kg (200 pounds) except round covers.
- E. Steel Frames:
  1. Form frame from structural steel angles as shown. Where not shown use 63 x 63 x 6 mm (2-1/2 x 2-1/2 x 1/4 inch) angles for frame openings over 1200 mm (4 feet) long and 50 x 50 x 6 mm (2 ix 2 x 1/4 inch) for frame openings less than 1200 mm (4 feet).

2. Fabricate intermediate supporting members from steel "T's" or angles; located to support cover section edges.
3. Where covers are required use steel border bars at frames so that top of cover will be flush with frame and finish floor.
4. Weld steel strap anchors to frame. Space straps not over 600 mm (24 inches) o.c., not shown otherwise between end anchors. Use 6 x 25 x 200 mm (1/4 x 1 x 8 inches) with 50 mm (2 inch) bent ends strap anchors unless shown otherwise.
5. Drill and tap frames for screw anchors where plate covers occur.

F. Cast Iron Frames:

1. Fabricate from ASTM A48 cast iron to shape shown.
2. Provide anchors for embedding in concrete, spaced near ends and not over 600mm (24 inches) apart.

## 2.8 GRATINGS

- A. Fabricate gratings to support live loads specified and a concentrated load as specified.
- B. Provide clearance at all sides to permit easy removal of grating.
- C. Make cutouts in gratings with 6 mm (1/4 inch) minimum to 25 mm (1 inch) maximum clearance for penetrations or passage of pipes and ducts. Edge band cutouts.
- D. Fabricate in sections not to exceed 2.3 m<sup>2</sup> (25 square feet) in area and 90 kg (200 pounds) in weight.
- E. Fabricate sections of grating with end-banding bars.
- F. Fabricate angle frames and supports, including anchorage as shown.
  1. Fabricate intermediate supporting members from "T's" or angles.
  2. Locate intermediate supports to support grating section edges.
  3. Fabricate frame to finish flush with top of grating.
  4. Locate anchors at ends and not over 600 mm (24 inches) o.c.
  5. Butt or miter, and weld angle frame at corners.
- G. Steel Bar Gratings:
  1. Fabricate grating using steel bars, frames, supports and other members shown in accordance with Metal Bar Grating Manual.
  2. Galvanize steel members after fabrication in accordance with ASTM A123, G-90 for exterior gratings, gratings in concrete floors, and interior grating where specified.
  3. Interior gratings: Prime paint unless specified galvanized.
  4. Use serrated bars for exterior gratings and interior gratings in the following areas:

5. Use riveted grating in the following areas:

H. Cast Iron Gratings:

1. Fabricate gratings to support a live load of 23940 Pa (500 pounds per square foot).
2. Fabricate gratings and frames for gutter type drains from cast-iron conforming to ASTM A48.
3. Fabricate gratings in section not longer than 1200 mm (4 feet) or over 90 kg (200 pounds) and fit so as to be readily removable.

I. Fiberglass Grating (for elevator sump pit)

1. Molded fiberglass grating made from polyester or vinylester resin matrix.
2. Pattern: Square, 38 mm x 38 mm (1-1/2 inch by 1-1/2 inch).
3. Height: 25 mm (1 inch).
4. Color: Orange.

## 2.9 SAFETY NOSINGS

A. Fed. Spec. RR-T-650, Type C.

1. Aluminum: Class 2, Style 2.
2. Cast iron: Class 4.

B. Fabricate nosings for exterior use from cast aluminum, and nosings for interior use from either cast aluminum or cast iron. Use one Class throughout.

C. Fabricate nosings approximately 100 mm (4 inches) wide with not more than 9 mm (3/8 inch) nose.

D. Provide nosings with integral type anchors spaced not more than 100 mm (4 inches) from each end and intermediate anchors spaced approximately 375 mm (15 inches) on center.

E. Fabricate nosings to extend within 100 mm (4 inches) of ends of concrete stair treads except where shown to extend full width.

F. Fabricate nosings to extend full width between stringers of metal stairs and full width of door openings.

G. On curved steps fabricate to terminate at point of curvature of steps having short radius curved ends.

## 2.10 LADDERS

A. Steel Ladders:

1. Fixed-rail type with steel rungs shouldered and headed into and welded to rails.

2. Fabricate angle brackets of 50 mm (2 inch) wide by 13 mm (1/2 inch) thick steel; brackets spaced maximum of 1200 mm (4 feet) apart and of length to hold ladder 175 mm (7 inches) from wall to center of rungs. Provide turned ends or clips for anchoring.
3. Provide holes for anchoring with expansion bolts through turned ends and brackets.
4. Where shown, fabricate side rails curved, twisted and formed into a gooseneck.
5. Galvanize exterior ladders after fabrication, ASTM A123, G-90.

B. Aluminum Ladders:

1. Fixed-rail type, constructed of structural aluminum, with mill finish.
2. Fabricate side rails and rungs of size and design shown, with the rungs shouldered and headed into and welded to the rails.
3. Where shown fabrication side rails curved, twisted and formed into gooseneck.
4. Fabricate angle brackets at top and bottom and intermediate brackets where shown. Drill for bolting.
5. Fabricate stringers and framing of steel plate or shapes. Bolt, rivet or weld connections and anchor to supporting construction. Provide treads with non-slip surface as specified for safety treads. Design assembly, including tread connections and methods of attachment, to support a live load of 1300 N (300 pounds) per tread. Provide railings as specified for metal handrails.

C. Elevator Pit Ladder:

1. Fabricate side rails and rungs of size and design shown, with rungs welded welded to the rails.
2. Fabricate angle brackets as shown drill for bolting.

D. Ladder Rungs:

1. Fabricate from 25 mm (one inch) diameter steel bars.
2. Fabricate so that rungs will extend at least 100 mm (4 inches) into wall with ends turned 50 mm (2 inches), project out from wall 175 mm (7 inches), be 400 mm (16 inches) wide and be designed so that foot cannot slide off end.
3. Galvanized after fabrication, ASTM A123, G-90 rungs for exterior use and for access to pits.

## 2.11 RAILINGS

- A. In addition to the dead load design railing assembly to support live load specified.
- B. Fabrication General:
  1. Provide continuous welded joints, dressed smooth and flush.

2. Standard flush fittings, designed to be welded, may be used.
  3. Exposed threads will not be approved.
  4. Form handrail brackets to size and design shown.
  5. Exterior Post Anchors.
    - a. Fabricate tube or pipe sleeves with closed ends or plates as shown.
    - b. Where inserts interfere with reinforcing bars, provide flanged fittings welded or threaded to posts for securing to concrete with expansion bolts.
    - c. Provide heavy pattern sliding flange base plate with set screws at base of pipe or tube posts.
  6. Interior Post Anchors:
    - a. Provide flanged fittings for securing fixed posts to floor with expansion bolts, unless shown otherwise.
    - b. Weld or thread flanged fitting to posts at base.
    - c. For securing removable posts to floor, provide close fitting sleeve insert or inverted flange base plate with stud bolts or rivets concrete anchor welded to the base plate.
    - d. Provide sliding flange base plate on posts secured with set screws.
    - e. Weld flange base plate to removable posts set in sleeves.
- C. Handrails (General):
1. Close free ends of rail with flush metal caps welded in place except where flanges for securing to walls with bolts are shown.
  2. Make provisions for attaching handrail brackets to wall, posts, and handrail as shown.
- D. Steel Pipe Railings:
1. Fabricate of steel pipe with welded joints.
  2. Number and space of rails as shown.
  3. Space posts for railings not over 1800 mm (6 feet) on centers between end posts.
  4. Form handrail brackets from malleable iron.
  5. Fabricate removable sections with posts at end of section.
  6. Finish: Hot-dip galvanize to comply with with ASTM A 123/A 123M.
- E. Stainless Steel Railings:
1. Fabricate from 38 mm (1-1/2 inches) outside diameter stainless steel tubing, ASTM A269, having a wall thickness of 1.6 mm (0.065 inch).
  2. Join sections by an internal connector to form hairline joints where field assembled.
  3. Fabricate with continuous welded connections.
  4. Fabricate brackets of stainless steel to design shown.

5. Fabricate stainless steel sleeves at least 150 mm (6 inches) deep having internal dimensions at least 13 mm (1/2 inch) greater than external dimensions of post.
- F. Stainless Steel Handrails (attached to walls):
1. Fabricated or manufactured stainless steel handrails, using Type 304 stainless steel.
  2. Fabricate from 38 mm (1-1/2 inches) outside diameter stainless steel tubing, ASTM A269, having a wall thickness of 1.6 mm (0.065 inch).
  3. Brackets: Stainless steel mounting bracket with concealed mounting flanges and snap-on flange covers.
  4. Elbows, end caps, spline connectors: Manufacturer's standard fittings.
  5. Adhesive: Type as recommended by handrail manufacturer.
  6. Finish: No. 4 brushed stainless steel.
- G. Ornamental Railings:
1. Point supported tempered glass railing infill, mounted on steel supports, with stainless steel handrails.
  2. Glass Infill: 12 mm tempered glass as specified in Section 08 80 00, GLAZING; edges polished and chamfered.
  3. Point Supported Mounting Fittings: Stainless steel.
    - a. Single Arm Wall/Fin Mounted Fitting: Wall to fin/post mounted fitting used to attach a single glass panel to steel post. Includes stainless steel threaded studs with matching cap nuts and washers.
    - b. Point Support Glass Attachment: Rigid head combination glass attachment fitting used for flush mounting with the glass fabricated with a countersunk hole.
    - c. Stud Fittings: Stud fittings for fin/post mounted spider fittings.
  4. Handrail: Stainless steel Type 304, cold-rolled, ornamental grade, No. 4 satin finish. 38 mm (1-1/2 inch) outer diameter by 3.76 mm (0.148 inch) thick wall thickness.
    - a. Join sections by an internal connector to form hairline joints where field assembled.
    - b. Fabricate with continuous welded connections.
    - c. Fabricate brackets of stainless steel to design shown. Fasten to steel posts using stainless steel 18-8 socket head (Allen) screws with cylindrical head.
  5. Balusters (Posts/Stanchions): Fabricate from steel shapes and bars.
    - a. Weld to steel stair stringer. Grind and finish exposed welds and surfaces smooth and blended so no roughness shows after finishing.
    - b. Drill and tap holes for fastening handrail brackets.

H. Glazed-Decorative Guard Railings: (ASI#043)

1. Engineer, fabricate, and install point supported tempered glass guard railing infill, mounted on steel supports, with stainless steel handrails.
2. Performance Requirements:
  - a. Delegated Design: Engage a professional engineer, licensed in the State of California to design railings, including attachment to building construction.
  - b. Engineer railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the current IBC, and the corresponding material codes on the following:
    - 1) Glass: 25 percent of mean modulus of rupture (50 percent probability of breakage), as listed in "Mechanical Properties" in AAMA's Aluminum Curtain Wall Series No. 12, "Structural Properties of Glass."
  - c. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads, all applicable loads per the IBC and ASCE 7, and the following loads and stresses within limits and under conditions indicated:
    - 1) Handrails and Top Rails of Guards:
      - a) Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
      - b) Concentrated load of 200 lbf (0.89 kN) applied in any direction.
      - c) Uniform and concentrated loads need not be assumed to act concurrently.
    - 2) Infill of Guards:
      - a) Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
      - b) Infill load and other loads need not be assumed to act concurrently.
3. Glass Infill: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated), Type 1 (transparent flat glass), Quality-Q3. Provide products that have been tested for surface and edge compression according to ASTM C 1048 and for impact strength according to 16 CFR 1201 for Category II materials
  - a. Thickness: As required to meet structural performance requirements but not less than 12 mm (1/2 inch).
  - b. Edges polished and chamfered.
  - c. Heat soak tested to convert nickel sulfide inclusions from the alpha phase to the beta phase so that the glass will fracture in the test.
4. Point Supported Mounting Fittings: Stainless steel.
  - a. Single Arm Wall/Fin Mounted Fitting: Wall to fin/post mounted fitting used to attach a single glass panel to steel post. Includes stainless steel threaded studs with matching cap nuts and washers.

- b. Point Support Glass Attachment: Rigid head combination glass attachment fitting with button head cap.
  - c. Stud Fittings: Stud fittings for fin/post mounted spider fittings.
- 5. Handrail: Stainless steel Type 304, cold-rolled, ornamental grade, No. 4 satin finish. 38 mm (1-1/2 inch) outer diameter by 3.76 mm (0.148 inch) thick wall thickness.
  - a. Join sections by an internal connector to form hairline joints where field assembled.
  - b. Fabricate with continuous welded connections.
  - c. Fabricate brackets of stainless steel to design shown. Fasten to steel posts using stainless steel 18-8 socket head (Allen) screws with cylindrical head.
- 6. Balusters (Posts/Stanchions): Fabricate from steel shapes and bars.
  - a. Weld or bolt to steel structure. Grind and finish exposed welds and surfaces smooth and blended so no roughness shows after finishing.
  - b. Drill and tap holes for fastening handrail brackets.
- 7. Finish:
  - a. Stainless steel fittings: No. 4 satin stainless steel.
  - b. Steel shapes: Shop primed (epoxy primer) for field painting (high-build epoxy coating).

I. Balcony Glass Guard: (ASI#043)

- 1. System Description: Clear laminated glass anchored to balcony wall using stand offs.
- 2. Structural Performance Requirements: Comply with performance requirements for glazed decorative guard railings.
- 3. Glass: Clear laminated glass; 1/2-inch thick; Two layers of 6 mm (1/4-inch) thick annealed glass, with 0.030 PVB interlayer.
- 4. Glass Stand-off with Caps: Fabricated from Type 316 stainless steel; with stainless steel mounting stud, type and length as appropriate to meet structural performance requirements.
  - a. Product (Basis of Design): C. R. Laurence; Cat. No. RSOB2134, or equal.

**2.12 STAINLESS STEEL GATE AT DECORATIVE METAL STAIRS**

- A. Fabricate from stainless steel Type 304, shapes, tubes, plates, and bars.
- B. Hardware: Provide stainless steel rising butt hinges. Drill and tap post and gate to install hinges. Use stainless steel mechanical screws.
- C. Finish: No. 4, brushed stainless steel.

**2.13 CATWALKS**

- A. Fabricate catwalks including platforms, railings, ladders, supports and hangers, and arrangement of members as shown on drawings.



- B. Fabricate steel ladders as specified under paragraph LADDERS unless shown otherwise.
- C. Fabricate steel pipe railings as specified under paragraph RAILINGS.
- D. Catwalk and platforms floor surfaces as shown.
  - 1. Steel gratings as specified under paragraph gratings, either bar or plank type.
- E. Galvanize catwalk system.

#### **2.14 SIDEWALK DOOR**

- A. Use flush, watertight, gutter type design.
- B. Cover fabricate of 6 mm (1/4 inch) thick, diamond pattern floor plate.
- C. Use automatic lock hold open feature and be hung on two flush type heavy bronze hinges capable of 90 degree swing on each door leaf.
- D. Equip with locking and latching device and lifting devices; operable and accessible from both sides of doors.
- E. Doors removable without disturbing frame.
- F. Provide gutters at all joints for drainage of water.

#### **2.15 STEEL COUNTER OR BENCH TOP FRAME AND LEGS**

- A. Fabricate channel or angle frame with mitered and welded corners as shown.
- B. Drill top of frame with 6 mm (1/4 inch) holes spaced 200 mm (8 inches) on center for securing countertop.
- C. Fabricate legs of angle or pipe shapes and continuously weld to frame.
- D. Finish frame with backed on enamel prime coat.

#### **2.16 CANOPY FRAMING AND GLAZED ROOFING**

- A. Canopy steel framing as shown on the Drawings. Finish: Hot-dip galvanized to comply with with ASTM A 123/A 123M. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Glazed Roofing: Polycarbonate sheet, refer to Section 08 80 00, GLAZING.
- C. Point Support Spider Fittings: Fabricated from Type 316 stainless steel, satin finish. Flange mount spider fittings for attaching glazing panels to structural framing with articulated head point-support attachment.
- D. Sealant: Silicone sealant; ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, and A.
  - 1. Color: Clear.

## **2.17 TRELLISING SYSTEM**

- A. Manufactured modular three-dimensional welded wire trellising system mounted on steel tubes and shapes and mechanically attached with pre-manufactured anchors and clips.
- B. Finish:
  - 1. Steel framing: Hot-dip galvanized after fabrication.
  - 2. Welded wire trellising: Factory finished with prime coat of zinc-rich epoxy powder coat and topcoat of polyester-urethane powder coat.

## **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.

#### B. Ceiling Hung Toilet Stalls:

1. Securely anchor hangers of continuous steel channel above pilasters to structure above.
2. Bolt continuous steel angle at wall to masonry or weld to face of each metal stud.
3. Secure brace for steel channels over toilet stall pilasters to wall angle supports with bolts at each end spaced as shown.
4. Install diagonal angle brace where the suspended ceiling over toilet stalls does not extend to side wall of room.
5. Install stud bolts in lower flange of channel before installing furred down ceiling over toilet stalls.
6. Install support for ceiling hung pilasters at entrance screen to toilet room similar to toilet stall pilasters.

#### C. Supports for Wall Mounted items:

1. Locate center of support at anchorage point of supported item.
2. Locate support at top and bottom of wall hung cabinets.
3. Locate support at top of floor cabinets and shelving installed against walls.
4. Locate supports where required for items shown.

#### D. Supports for Cubicle Curtain Track:

1. Install assembly where shown after ceiling suspension grid is installed.
2. Drill angle for bolt and weld nut to angle prior to installation of tile.

#### E. Supports for Trapeze Bars:

1. Secure plates to overhead construction with fasteners as shown.
2. Secure angle brace assembly to overhead construction with fasteners as shown and bolt plate to braces.

3. Fit modular channel unit flush with finish ceiling, and secure to plate with modular channel unit manufacturer's standard fittings through steel shims or spreaders as shown.
  - a. Install closure plates in channel between eye bolts.
  - b. Install eyebolts in channel.

### **3.3 COVERS AND FRAMES FOR PITS AND TRENCHES**

- A. Set frame and cover flush with finish floor.
- B. Secure plates to frame with flat head countersunk screws.
- C. Set gratings loose in drainage trenches or over pits unless shown anchored.

### **3.4 DOOR FRAMES**

- A. Secure clip angles at bottom of frames to concrete slab with expansion bolts as shown.
- B. Level and plumb frame; brace in position required.
- C. Set frames in formwork for frames cast into concrete.
- D. Where frames are set in prepared openings, bolt to wall with spacers and expansion bolts.

### **3.5 OTHER FRAMES**

- A. Set frame flush with surface unless shown otherwise.
- B. Anchor frames at ends and not over 450 mm (18 inches) on centers unless shown otherwise.
- C. Set in formwork before concrete is placed.

### **3.6 GUARDS**

- A. Channel Guard at Top Edge of Concrete Platforms:
  1. Install in formwork before concrete is placed.
  2. Set channel flush with top of the platform.

### **3.7 GRATINGS**

- A. Set grating flush with finish floor; top of curb, or areaway wall. Set frame so that horizontal leg of angle frame is flush with face of wall except when frame is installed on face of wall.
- B. Set frame in formwork before concrete is placed.
- C. Where grating terminates at a wall bolt frame to concrete or masonry with expansion bolts unless shown otherwise.

- D. Secure removable supporting members in place with stainless steel bolts.
- E. Bolt gratings to supports.

### **3.8 SAFETY NOSINGS**

- A. Except as specified and where preformed rubber treads are shown or specified install safety nosings at the following:
  - 1. Exterior concrete steps.
  - 2. Exposed edges of curbs of door sills at transformer and service rooms.
  - 3. Interior concrete steps, including concrete filled treads of metal stairs of service stairs.
- B. Install flush with horizontal and vertical surfaces.
- C. Install nosing to within 100 mm (4 inches) of ends of concrete stair treads, except where shown to extend full width.
- D. Extend nosings full width of door openings.
- E. Extend nosings, full width between stringers of metal stairs, and terminate at point of curvature of steps having short radius curved ends.

### **3.9 LADDERS**

- A. Anchor ladders to walls and floors with expansion bolts through turned lugs or angle clips or brackets.
- B. In elevator pits, set ladders to clear all elevator equipment where shown on the drawings.
  - 1. Where ladders are interrupted by division beams, anchor ladders to beams by welding, and to floors with expansion bolts.
  - 2. Where ladders are adjacent to division beams, anchor ladders to beams with bent steel plates, and to floor with expansion bolts.
- C. Ladder Rungs:
  - 1. Set ladder rungs into formwork before concrete is placed.
  - 2. Set step portion of rung 150 mm (6 inches) from wall.
  - 3. Space rungs approximately 300 mm (12 inches) on centers.
  - 4. Where only one rung is required, locate it 400 mm (16 inches) above the floor.

### **3.10 RAILINGS**

- A. Steel Posts:
  - 1. Secure fixed posts to concrete with expansion bolts through flanged fittings except where sleeves are shown with pourable grout.
  - 2. Install sleeves in concrete formwork.

3. Set post in sleeve and pour grout to surface. Apply beveled bead of urethane sealant at perimeter of post or under flange fitting as specified in Section 07 92 00, JOINT SEALANTS—on exterior posts.
4. Secure posts to steel with welds.

B. Ornamental Railing Posts:

1. Weld to steel stair stringer. Grind and finish exposed welds and surfaces smooth and blended so no roughness shows after finishing.
2. Install point-support glass fittings and glass railing as detailed and in accordance with manufacturer's instructions.
3. Fasten stainless steel brackets and railing to posts.

C. Handrails:

1. Anchor brackets for metal handrails as detailed.
2. Install brackets within 300 mm (12 inches) of return of walls, and at evenly spaced intermediate points not exceeding 1200 mm (4 feet) on centers unless shown otherwise.
3. Expansion bolt to concrete.
4. Toggle bolt to installed supporting frame wall unless shown otherwise.

**3.11 CATWALK AND PLATFORMS**

- A. Expansion bolt members to concrete unless shown otherwise.
- B. Bolt or weld structural components together including ladders and stairs to support system.
- C. Weld railings to structural framing.
- D. Bolt or weld walk surface to structural framing.
- E. Smooth field welds and spot prime damaged prime paint surface.
- F. Fasten removable members with stainless steel fasteners.

**3.12 SIDEWALK DOOR, TRAP DOORS, AND FRAMES**

- A. Set frame flush with finished concrete slab or curb.
- B. Secure well linings to structure with expansion bolts unless shown otherwise.
- C. Bolt ceiling hatch to well lining angle brace and to angle iron frames near corners and 300 mm (12 inches) on centers with not less than 9 mm (3/8 inch) roundhead machine screws.
- D. Coordinate sidewalk door drain connections with plumbing work.

**3.13 STEEL COMPONENTS FOR MILLWORK ITEMS**

- A. Coordinate and deliver to Millwork fabricator for assembly where millwork items are secured to metal fabrications.

**3.14 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.

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(ASI#043) 02/01/2013; Architect's Supplemental Instructions No. 043

**SECTION 06 10 00**

**ROUGH CARPENTRY**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Section specifies wood blocking, nailers, and rough hardware.

**1.2 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings showing framing connection details, fasteners, connections and dimensions.

**1.3 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 150 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.

**1.4 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):
  - 1. NDS-05 Conventional Wood Frame Construction
- C. American Institute of Timber Construction (AITC):
  - 1. A190.1-02 Structural Glued Laminated Timber
- D. American Society of Mechanical Engineers (ASME):
  - 1. B18.6.1-81 (R97) Wood Screws
  - 2. B18.6.4-98 (R2005) Thread Forming and Thread Cutting Tapping Screws and Metallic Drive Screws



- E. American Plywood Association (APA):
1. E30-03 Engineered Wood Construction Guide
- F. American Society for Testing And Materials (ASTM):
1. A47-99(R2004) Ferritic Malleable Iron Castings
  2. A48-03 Gray Iron Castings
  3. A653/A653M-07 Steel Sheet Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot Dip Process
  4. C954-04 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
  5. C1002-04 Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Metal Studs
  6. D143-94(R2004) Small Clear Specimens of Timber, Method of Testing
  7. D1760-01 Pressure Treatment of Timber Products
  8. D2559-04 Adhesives for Structural Laminated Wood Products for Use Under Exterior (Wet Use) Exposure Conditions
  9. D3498-03 Adhesives for Field-Gluing Plywood to Lumber Framing for Floor Systems
  10. F844-07 Washers, Steel, Plan (Flat) Unhardened for General Use
  11. F1667-05 Nails, Spikes, and Staples
- G. Federal Specifications (Fed. Spec.):
1. MM-L-736C Lumber; Hardwood
- H. Commercial Item Description (CID):
1. A-A-55615 Shield, Expansion (Wood Screw and Lag Bolt Self Threading Anchors)
- I. Military Specification (Mil. Spec.):
1. MIL-L-19140E Lumber and Plywood, Fire-Retardant Treated
- J. Truss Plate Institute (TPI):
1. TPI-85 Metal Plate Connected Wood Trusses
- K. U.S. Department of Commerce Product Standard (PS)
1. PS 1-95 Construction and Industrial Plywood
  2. PS 20-05 American Softwood Lumber Standard

## **PART 2 - PRODUCTS**

### **2.1 LUMBER**

- A. Unless otherwise specified, each piece of lumber bear grade mark, stamp, or other identifying marks indicating grades of material, and rules or standards under which produced.
1. Identifying marks 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. 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. Furring, blocking, nailers and similar items 100 mm (4 inches) and narrower Standard Grade; and, members 150 mm (6 inches) and wider, Number 2 Grade.
- C. Sizes:
1. Conforming to Prod. Std., PS20.
  2. Size references are nominal sizes, unless otherwise specified, actual sizes within manufacturing tolerances allowed by standard under which produced.
- D. Moisture Content:
1. At time of delivery and maintained at the site.
  2. Boards and lumber 50 mm (2 inches) and less in thickness: 19 percent or less.
  3. Lumber over 50 mm (2 inches) thick: 25 percent or less.
- E. Fire Retardant Treatment:
1. Mil Spec. MIL-L-19140 with piece of treated material bearing identification of testing agency and showing performance rating.
  2. Treatment and performance inspection, by an independent and qualified testing agency that establishes performance ratings.
- F. 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 600 mm (24 inches) from ground; nailers, edge strips, blocking, crickets, curbs, cant, vent strips and other members used 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 ASTM D1760, except any process involving the use of Chromated Copper arsenate (CCA) for pressure treating wood is not permitted.

## 2.2 PLYWOOD

- A. Comply with Prod. Std., 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. Plywood Backing for Electrical and Telecommunication Room:
  1. APA A-C EXT, Douglas Fir with A face exposed; fire-retardant treated (FRT) bearing identification mark indicating flame spread classification (25 or less per ASTM E84) issued by approval agency.
  2. Size: 19 mm (3/4 inch) thick.
  3. Paint plywood backing per Section 09 91 00, PAINTING. Leave FRT label unpainted.

## 2.3 ROUGH HARDWARE AND ADHESIVES

- A. 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. Use 13 mm (1/2 inch) bolt unless shown otherwise.
- B. Washers:
  1. ASTM F844.
  2. Use zinc or cadmium coated steel or cast iron for washers exposed to weather.
- C. Screws:
  1. Wood to Wood: ANSI B18.6.1 or ASTM C1002.
  2. Wood to Steel: ASTM C954, or ASTM C1002.
- D. Nails:
  1. Size and type best suited for purpose unless noted otherwise. Use 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.

E. Adhesives:

1. For field-gluing plywood to lumber framing floor or roof systems: ASTM D3498.
2. For structural laminated Wood: ASTM D2559.

**PART 3 - EXECUTION**

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

A. Fasteners:

1. 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 use expansion bolts. Special bolts or screws designed for anchor to solid masonry or concrete in drilled holes may be used.
  - d. Use toggle bolts to hollow masonry or sheet metal.
  - e. Use 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 600 mm (24 inch) intervals between end bolts. Use clips to beam flanges.
2. 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 C 954 for steel over 0.84 mm (0.033 inch) thick.
3. Power actuated drive pins may be used where practical to anchor to solid masonry, concrete, or steel.
4. Do not anchor to wood plugs or nailing blocks in masonry or concrete. Use metal plugs, inserts or similar fastening.
5. 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.

B. Blocking Nailers, and Furring:

1. Install furring, blocking, nailers, and grounds where shown.
2. Use longest lengths practicable.
3. Use fire retardant treated wood blocking where shown at openings and where shown or specified.

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**SECTION 07 13 26**

**SELF-ADHERING SHEET WATERPROOFING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Section specifies bonded HDPE sheet waterproofing.

**1.2 QUALITY CONTROL**

- A. Approval by the Resident Engineer is required of products of proposed manufacturers.
- B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.
- C. Preinstallation Conference: Conduct conference at Project site.
1. Review waterproofing requirements including surface preparation, substrate condition, forecasted weather conditions, special details and sheet flashings, installation procedures, and protection and repairs.

**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. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.
- C. Shop Drawings: Show locations and extent of waterproofing and details of substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.
- D. Samples: For each exposed product and for each color and texture specified, including the following products:
1. 200-by-200-mm (8-by-8-inch) square of waterproofing sheet.
2. 100-by-100-mm (4-by-4-inch) square of drainage panel.

**1.4 PRODUCT DELIVERY, STORAGE AND HANDLING**

- A. Deliver materials to job in manufacturer's original unopened containers with brand name marked thereon.

- B. Unload and store so as to prevent injury to materials.
- C. Do not store material in areas where temperature is lower than 10° C (50° F), or where prolonged temperature is above 32°C (90°F).

#### 1.5 FIELD CONDITIONS

- A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer.
  - 1. Do not apply waterproofing in snow, rain, fog, or mist.

#### 1.6 WARRANTY

- A. Self-adhering sheet waterproofing is subject to the terms of Article titled "Warranty of Construction", FAR clause 52.246-21, and as follows:
  - 1. Manufacturer's Warranty: Manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight for warranty period of five years.
  - 2. Installer's Warranty: Signed by Installer, covering Work of this Section, for warranty period of two years.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS, GENERAL

- A. Source Limitations for Waterproofing System: Obtain waterproofing materials and molded-sheet drainage panels from single source from single manufacturer.

#### 2.2 BONDED HDPE OR POLYETHYLENE SHEET WATERPROOFING

- A. Bonded HDPE Sheet for Vertical Applications: Uniform, flexible, multilayered-composite sheet membrane consisting of an HDPE film coated with a pressure-sensitive adhesive and protective release liner, total 32-mil (0.8-mm) thickness, with the following physical properties:
  - 1. Tensile Strength, Film: 4000 psi (27.6 MPa) minimum; ASTM D 412.
  - 2. Low-Temperature Flexibility: Pass at minus 10 deg F (minus 23 deg C); ASTM D 1970.
  - 3. Peel Adhesion to Concrete: 5 lbf/in. (875 N/m) minimum; ASTM D 903, modified.
  - 4. Lap Adhesion: 2.5 lbf/in. (440 N/m) minimum; ASTM D 1876, modified.
  - 5. Hydrostatic-Head Resistance: 231 feet (70 m); ASTM D 5385, modified.
  - 6. Puncture Resistance: 100 lbf (445 N) minimum; ASTM E 154.
  - 7. Water Vapor Permeance: 0.01 perms (0.6 ng/Pa x s x sq. m) maximum; ASTM E 96/E 96M, Water Method.
  - 8. Water Absorption: 0.5 percent maximum; ASTM D 570.

- B. Bonded HDPE or Polyethylene Sheet for Horizontal Applications: Uniform, flexible, multilayered-composite sheet membrane consisting of an HDPE film coated with pressure-sensitive adhesive and protective release liner, total 46-mil (1.2-mm) thickness, with the following physical properties:
1. Tensile Strength, Film: 4000 psi (27.6 MPa) minimum; ASTM D 412.
  2. Low-Temperature Flexibility: Pass at minus 10 deg F (minus 23 deg C); ASTM D 1970.
  3. Peel Adhesion to Concrete: 5 lbf/in. (875 N/m) minimum; ASTM D 903, modified.
  4. Lap Adhesion: 2.5 lbf/in. (440 N/m) minimum; ASTM D 1876, modified.
  5. Hydrostatic-Head Resistance: 231 feet (70 m); ASTM D 5385, modified.
  6. Puncture Resistance: 221 lbf (990 N) minimum; ASTM E 154.
  7. Water Vapor Permeance: 0.01 perms (0.6 ng/Pa x s x sq. m) maximum; ASTM E 96/E 96M, Water Method.
  8. Water Absorption: 0.5 percent maximum; ASTM D 570.
- C. Mastic, Adhesives, and Detail Tape: Liquid mastic and adhesives, and adhesive tapes recommended by waterproofing manufacturer.

### 2.3 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.
1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.
- B. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, of trowel grade or low viscosity.

### 2.4 MOLDED-SHEET DRAINAGE PANELS

- A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Composite subsurface drainage panel consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 (0.21-mm) sieve laminated to one side of the core and a polymeric film bonded to the other side; and with a vertical flow rate of 9 to 15 gpm per ft. (112 to 188 L/min. per m).

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the waterproofing.
1. Verify that compacted subgrade is dry, smooth, sound, and ready to receive molded-sheet drainage panels and waterproofing sheet.

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

### 3.2 SURFACE PREPARATION

- A. Clean and prepare substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

### 3.3 BONDED HDPE OR POLYETHYLENE SHEET-WATERPROOFING APPLICATION

- A. Install bonded HDPE or polyethylene sheets according to manufacturer's written instructions.
- B. Place and secure molded-sheet drainage panels over substrate. Lap edges and ends of geotextile to maintain continuity.
- C. Vertical Applications: Install sheet with HDPE face against substrate. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required by membrane manufacturer. Overlap and seal seams, and stagger and tape end laps to ensure watertight installation. Mechanically fasten to substrate.
  - 1. Securely fasten top termination of membrane with continuous metal termination bar anchored into substrate and cover with detailing tape.
- D. Horizontal Applications: Install sheet with HDPE or polyethylene face against substrate. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required by membrane manufacturer. Overlap and seal seams, and stagger and tape end laps to ensure watertight installation.
- E. Corners: Seal lapped terminations and cut edges of sheet waterproofing at inside and outside corners with detail tape.
- F. Seal penetrations through sheet waterproofing to provide watertight seal with detail tape patches or wraps and a liquid-membrane troweling.
- G. Install sheet-waterproofing and auxiliary materials to produce a continuous watertight waterproofing.
- H. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Tape perimeter of damaged or nonconforming area extending 6 inches (150 mm) beyond repaired areas in all directions. Apply a patch of sheet waterproofing and firmly secure with detail tape.

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**SECTION 07 26 13.13**

**CONCRETE SLAB APPLIED VAPOR RETARDER**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section includes water vapor retarders applied on concrete floor slab scheduled to receive floor finishes, which do not meet the water vapor emission limits specified.

**1.2 RELATED WORK**

- A. Concrete floor slab: Section 03 30 00, CAST-IN-PLACE CONCRETE.
- B. Concrete floor slab water vapor emission limits for resilient sheet flooring: Section 09 65 16, RESILIENT SHEET FLOORING.
- C. Concrete floor slab water vapor emission limits for resilient tile flooring: Section 09 65 19, RESILIENT TILE FLOORING.
- D. Concrete floor slab water vapor emission limits for carpeting: Section 09 68 00, CARPETING.

**1.3 APPLICABLE PUBLICATIONS**

- A. Applicable publications listed below form a part of this Specification as referenced. Publications are referenced in the text by the number designation only.
- B. American Society for Testing and Materials (ASTM):
  - 1. D1308-02 Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes
  - 2. D4541-09 Test Method for Pull-off Strength of Coatings Using Portable Adhesion Testers
  - 3. E96/E96M-05 Test Method for Water Vapor Transmission of Materials
  - 4. F710-08 Preparing Concrete Floors to Receive Resilient Flooring
  - 5. F1869-09 Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
  - 6. F2170-09 Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes

**1.4 WARRANTY**

- A. Concrete slab applied vapor retarder is subject to terms of "Warranty of Construction", FAR clause 52.246-21, except that warranty period is extended to ten years.

### **1.5 QUALITY CONTROL**

- A. Applicator Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Pre-installation Conference: Conduct conference at Project site.

### **1.6 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Product Data: Include product performance characteristics, test reports, and application instructions.
- C. Qualification Data: For Applicator.
- D. Product Test Reports: For applied vapor retarder, for tests performed by manufacturer and witnessed by a qualified testing agency.
- E. Field quality-control reports.
- F. Warranty: As specified in Part 1 of this Section:
  - 1. Warranty sample form with specific language to address Contract provisions.

### **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver liquid materials to Project site in original containers with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, shelf life, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by manufacturer.
- C. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- D. Protect stored materials from direct sunlight.

## **PART 2 - PRODUCTS**

### **2.1 VAPOR RETARDERS**

- A. Epoxy-based vapor retarder; reduces moisture vapor emission rates up to 20 lbs per 1,000 sq. ft. (9.07 kg per 92.9 m<sup>2</sup>) per 24 hours.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Water vapor transmission rate reduction: 90 percent or greater, as tested in accordance with ASTM E 96, water method.
- B. Post vapor retarder application, water vapor emission: Restrict 20 lb of water/1000 sq. ft. (9.07 kg of water/92.9 sq. m) to 3.0 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours, as tested in accordance with ASTM F 1869, as modified to exclude removal of the applied sealer/vapor retarder, prior to placement of anhydrous calcium chloride tests.
- C. Adhesion to concrete: 500 psi (3,450 KPa) or greater, as tested in accordance with ASTM D 4541.
- D. Chemical resistance: No physical damage by 14pH, as tested in accordance with ASTM D 1308.
- E. Relative humidity resistance test to 100% RH: 75% RH, as tested in accordance with ASTM F 2170.
- F. VOC Content: Products shall comply with VOC limits of Bay Area Air Quality Management District (BAAQMD), Reg. 8, Rule 3, effective 01/01/2011, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 1. Sealers: 100 g/L.

## 2.3 ACCESSORIES

- A. Concrete Testing Equipment: Subject to compliance with requirements, provide the following products by American Moisture Test, Inc.:
  - 1. Calcium Chloride (CC) Moisture Test Kit for ASTM F 1869.
  - 2. In-Situ Relative Humidity Meter and Probe for ASTM F 2170.
  - 3. Digital Ph Meter for ASTM F 2170.
  - 4. Temperature and Data Humidity Logger.
  - 5. Infrared surface temperature meter.
- B. Primers and Cement Topcoat: Where primers and cement topcoats are necessary for floor finishing installation, use primer and cement-based underlayment products recommended by vapor retarder manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Water Vapor Emission Testing:
  - 1. Perform pre-installation testing of the concrete slab prior to the application of applied vapor retarder. Testing shall be performed by a qualified testing personnel and testing laboratory.
  - 2. Condition the area to be tested for at least 48 hours prior to testing to allow the concrete slab to reach equilibrium with the building's

ambient conditions at the service temperature and humidity expected during normal operation. Maintain the temperature and relative humidity for the duration of the testing.

- B. Perform three tests for the first 1000 sq. ft. (92.9 sq. m) of flooring. Add one test for each additional 1000 sq. ft. (92.9 sq. m) or fraction thereof. Conduct tests around the perimeters of the room, at columns, and where moisture may be evident.
1. Moisture:
    - a. Perform ASTM F 1869 anhydrous calcium chloride testing on clean concrete slabs; free of curing, sealing, adhesive residue, water and surface contaminants in an area 20-inches by 20-inches, 24-hours before test kits are installed.
    - b. Perform ASTM F 2170 in situ hygrometer probe test at depth of 40% slab thickness for concrete slab that is allowed to dry from top only, and at depth of 20% of slab thickness for concrete slab that is allowed to dry from top and bottom.
  2. Alkalinity: Perform ASTM F 710 alkalinity testing during retrieval of moisture tests, directly inside dome area by placing several drops of manufacturer provided solution to concrete surface. Wait 60-seconds and apply digital LCD pH meter. Record results to the nearest hundredth on final test report.
  3. Temperature, Humidity and Surface Thermometer: Document temperature, humidity and surface temperature before testing at installation of kits or probe sleeves, and on final testing report.
  4. Temperature and Humidity Data Logger: Install a data logger to document temperature and humidity before testing at installation of kits or probe sleeves, and on final testing report.
  5. Infrared Surface Thermometer: Document concrete surface temperature at start of testing and at end of testing. Provide results on testing report.
  6. Record on finish floor plans the number and location of tests conducted on concrete surface.

### 3.2 SURFACE PREPARATION

- A. Concrete surfaces to be tested shall be clean and free of residue, debris, and sealing compounds.
- B. Shot blast concrete surfaces to an International Concrete Repair Institute - ICRI#4 profile using #420 shot to expose clean absorbent layers.
- C. Diamond-grind concrete surface near wall base, edges, and corners.
- D. Sweep and vacuum clean substrates as required, immediately before application of vapor retarder.

### 3.3 APPLICATION

- A. Apply vapor retarder by squeegee, spray, and/or roller method to saturate the concrete surface. Apply materials in accordance with manufacturer's instructions.
- B. Coverage rates shall be in accordance with manufacturer's recommendations based on concrete density and porosity.
- C. Allow materials to penetrate and cure. Re-test substrate and re-apply vapor retarder if areas exceed the following:
  - 1. ASTM F 1869: Water vapor emission not to exceed 3.0 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours
  - 2. ASTM F 710: Alkalinity not to exceed 9.0 pH.

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**SECTION 07 81 00**

**APPLIED FIREPROOFING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies mineral fiber and cementitious coverings to provide fire resistance to interior structural steel members shown.

**1.2 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
1. Manufacturer's complete and detailed application instructions and specifications.
  2. Manufacturer's repair and patching instructions.
- C. Certificates:
1. Certificate from testing laboratory attesting fireproofing material and application method meet the specified fire ratings.
    - a. List thickness and density of material required to meet fire ratings.
    - b. Accompanied by complete test report and test record.
  2. Manufacturer's certificate indicating sprayed-on fireproofing material supplied under the Contract is same within manufacturing tolerance as fireproofing material tested.
- D. Miscellaneous:
1. Manufacturer's written approval of surfaces to receive sprayed-on fireproofing.
  2. Manufacturer's written approval of completed installation.
  3. Manufacturer's written approval of the applicators of fireproofing material.

**1.3 PRODUCT DELIVERY, STORAGE AND HANDLING**

- A. Deliver to jobsite in sealed containers marked and labeled to show manufacturer's name and brand and certification of compliance with the specified requirements.
- B. Remove damaged containers from the site.
- C. Store the materials off the ground, under cover, away from damp surfaces.

- D. Keep dry until ready for use.
- E. Remove materials that have been exposed to water before installation from the site.

#### 1.4 QUALITY CONTROL

- A. Test for fire endurance in accordance with ASTM E119, for fire rating specified, in a nationally recognized laboratory.
- B. Manufacturer's inspection and approval of surfaces to receive fireproofing as specified under paragraph Examination.
- C. Manufacturer's approval of fireproofing applications.
- D. Manufacturer's approval of completed installation.
- E. Manufacturer's representative shall observe and advise at the commencement of application, and shall visit the site as required thereafter for the purpose of ascertaining proper application.
- F. Pre-Application Test Area.
  - 1. Apply a test area consisting of a typical overhead fireproofing installation, including not less than 4.5 m (15 feet) of beam and deck.
    - a. Apply to one column.
    - b. Apply for the hourly ratings used.
  - 2. Install in location selected by the Resident Engineer, for approval by the representative of the fireproofing material manufacturer and by the Government.
  - 3. Perform Bond test on painted steel in accordance with ASTM E736.
  - 4. Do not proceed in other areas until installation of test area has been completed and approved.
  - 5. Keep approved installation area open for observation as criteria for sprayed-on fireproofing.

#### 1.5 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):
  - 1. C841-03 Installation of Interior Lathing and Furring
  - 2. C847-06 Metal Lath
  - 3. E84-08 Surface Burning Characteristics of Building Materials
  - 4. E119-08 Fire Tests of Building Construction and Materials
  - 5. E605-93 (R2006) Thickness and Density of Sprayed Fire-Resistive Materials Applied to Structural Members

6. E736-00 Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members
  7. E759-92 (R2005) The Effect of Deflection on Sprayed Fire-Resistive Material Applied to Structural Members
  8. E760-92 (R2005) Impact on Bonding of Sprayed Fire-Resistive Material Applied to Structural Members
  9. E761-92 (R2005) Compressive Strength of Fire-Resistive Material Applied to Structural Members
  10. E859-93 (R2006) Air Erosion of Sprayed Fire-Resistive Materials Applied to Structural Members
  11. E937-93 (R2005) Corrosion of Steel by Sprayed Fire-Resistive Material Applied to Structural Members
  12. E1042-02 Acoustically, Absorptive Materials Applied by Trowel or Spray.
  13. G21-96 (R2002) Determining Resistance of Synthetic Polymeric Materials to Fungi
- C. Underwriters Laboratories, Inc. (UL):
1. Fire Resistance Directory Latest Edition including Supplements
- D. Warnock Hersey (WH):
1. Certification Listings Latest Edition
- E. Factory Mutual System (FM):
1. Approval Guide Latest Edition including Supplements

## **PART 2 - PRODUCTS**

### **2.1 SPRAYED-ON FIREPROOFING**

- A. ASTM E1042, Class (a), Category A.
  1. Type I (not used).
  2. Type II, factory mixed mineral fiber with integral inorganic binders minimum 240 kg/m<sup>3</sup> (15 lb/ft<sup>3</sup>) density per ASTM E605 test unless specified otherwise. Use in areas that are completely encased.
- B. Materials containing asbestos are not permitted.
- C. Fireproofing characteristics when applied in the thickness and density required to achieve the fire-rating specified.



	Characteristic	Test	Results
1.	Deflection	ASTM E759	No cracking, spalling, or delamination when backing to which it is applied has a deflection up to 1/120 in 3 m (10 ft.)
2.	Corrosion-Resistance	ASTM E937	No promotion of corrosion of steel.
3.	Bond Impact	ASTM E760	No cracking, spalling, or delamination.
4.	Cohesion/Adhesion (Bond Strength)	ASTM E736	Minimum cohesive/adhesive strength of 9.57 kPa (200 lbf/ft <sup>2</sup> ) for protected areas. 19.15 kPa (400 lbf/ft <sup>2</sup> ) for exposed areas.
5.	Air Erosion	ASTM E859	Maximum gain weight of the collecting filter 0.27gm/m <sup>2</sup> (0.025 gm/ft <sup>2</sup> ).
6.	Compressive Strength	ASTM E761	Minimum compressive strength 36 kPa (5 lbf/in <sup>2</sup> ).
7.	Surface Burning Characteristics with adhesive and sealer to be used	ASTM E84	Flame spread 25 or less smoke developed 50 or less
8.	Fungi Resistance	ASTM G21	Resistance to mold growth when inoculated with aspergillus niger (28 days for general application)

## 2.2 ADHESIVE

- A. Bonding adhesive for Type II (fibrous) materials as recommended and supplied by the fireproofing material manufacturer.
- B. Adhesive may be an integral part of the material or applied separately to surface receiving fireproofing material.

## 2.3 SEALER

- A. Sealer for Type II (fibrous) material as recommended and supplied by the fireproofing material manufacturer.
- B. Surface burning characteristics as specified for fireproofing material.
- C. Fungus resistant.
- D. Sealer may be an integral part of the material or applied separately to the exposed surface. When applied separately use contrasting color pigmented sealer, white preferred.

#### **2.4 WATER**

- A. Clean, fresh, and free from organic and mineral impurities.
- B. pH of 6.9 to 7.1.

#### **2.5 MECHANICAL BOND MATERIAL**

- A. Expanded Metal Lath: ASTM C847, minimum weight of 0.92 kg/m<sup>2</sup> (1.7 pounds per square yard).
- B. Fasteners: ASTM C841.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify surfaces to receive fireproofing are clean and free of dust, soot, oil, grease, water soluble materials or any foreign substance which would prevent adhesion of the fireproofing material.
- B. Verify hangers, inserts and clips are installed before the application of fireproofing material.
- C. Verify ductwork, piping, and other obstructing material and equipment is not installed that will interfere with fireproofing installation.
- D. Verify concrete work on steel decking and concrete encased steel is completed.
- E. Verify temperature and enclosure conditions are required by fireproofing material manufacturer.

#### **3.2 APPLICATION**

- A. Do not start application until written approval has been obtained from manufacturer of fireproofing materials that surfaces have been inspected by the manufacturer or his representative, and are suitable to receive sprayed-on fireproofing.
- B. Coordinate application of fireproofing material with other trades.
- C. Application of Metal Lath:
  - 1. Apply to beam and columns having painted surfaces which fail ASTM E736 Bond Test requirements in pre-application test area.
  - 2. Apply to beam flanges 300 mm (12 inches) or more in width.
  - 3. Apply to column flanges 400 mm (16 inches) or more in width.
  - 4. Apply to beam or column web 400 mm (16 inches) or more in depth.
  - 5. Tack weld or mechanically fasten on maximum of 300 mm (12 inch) center.
  - 6. See design criteria section of the approved assemblies used.

7. Lap and tie lath member in accordance with ASTM C841.
- D. Mix and apply in accordance with manufacturer's instructions.
  1. Mechanically control material and water ratios.
  2. Apply adhesive and sealer, when not an integral part of the materials, in accordance with the manufacturer's instructions.
  3. Apply to density and thickness indicated in UL Fire Resistance Directory, FM Approval Guide, or WH Certification Listings unless specified otherwise. Test in accordance with ASTM E119.
- E. Application shall be completed in one area, inspected and approved by Resident Engineer before removal of application equipment and proceeding with further work.

### **3.3 FIELD TESTS**

- A. Tests of applied material will be performed by VA retained Testing Laboratory. See Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Resident Engineer will select area to be tested in specific bays on each floor using a geometric grid pattern.
- C. Test for thickness and density in accordance with ASTM E605. Areas showing thickness less than that required as a result of fire endurance test will be rejected.
- D. Areas showing less than required fireproofing characteristics will be rejected on the following field tests.
  1. Test for cohesion/adhesion: ASTM E736.
  2. Test for bond impact strength: ASTM E760.

### **3.4 PATCHING AND REPAIRING**

- A. Inspect after mechanical, electrical and other trades have completed work in contact with fireproofing material, but before sprayed material is covered by subsequent construction.
- B. Perform corrective measures in accordance with fireproofing material Manufacturer's recommendations.
  1. Respray areas requiring additional fireproofing material to provide the required thickness, and replace dislodged or removed material.
  2. Spray material for patching by machine directly on point to be patched, or into a container and then hand apply.
  3. Hand mixing of material is not permitted.
- C. Repair:
  1. Respray all test and rejected areas.
  2. Patch fireproofing material which is removed or disturbed after approval.

- D. Perform final inspection of sprayed areas after patching and repair.

**3.5 SCHEDULE**

- A. Apply fireproofing material in interior structural steel members, except on following surfaces:
  - 1. Steel to be encased in concrete or designated to receive other type of fireproofing.
- B. Type II:
  - 1. Two hour fire rating.

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**SECTION 07 92 00**

**JOINT SEALANTS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. 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. Mockups: Section 01 43 39.13, VISUAL MOCKUPS.
- B. Sealing of site work concrete paving: Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.
- C. Firestopping penetrations: Section 07 84 00, FIRESTOPPING.
- D. Glazing: Section 08 80 00, GLAZING.
- E. Glazed aluminum curtain wall: Section 08 44 13, GLAZED ALUMINUM CURTAIN WALLS.
- F. Sound rated gypsum partitions/sound sealants: Section 09 29 00, GYPSUM BOARD.
- G. Mechanical Work: Section 21 05 11, COMMON WORK RESULTS FOR FIRE SUPPRESSION  
Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING  
Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

**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 inservice 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 Contracting Officer.
  2. Conduct field tests for each application indicated below:
    - a. Each type of elastomeric sealant and joint substrate indicated.
    - b. Each type of nonelastomeric sealant and joint substrate indicated.
  3. Notify Resident Engineer 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. VOC: Acrylic latex and Silicon sealants shall have less than 50g/l VOC content.
- F. 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 4.4° C (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 5° C (40° F) or less than 32° C (90° 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", FAR clause 52.246-21, 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):
1. C509-06 Elastomeric Cellular Preformed Gasket and Sealing Material.
  2. C612-04 Mineral Fiber Block and Board Thermal Insulation.
  3. C717-07 Standard Terminology of Building Seals and Sealants.
  4. C834-05 Latex Sealants.
  5. C919-02. Use of Sealants in Acoustical Applications.
  6. C920-05 Elastomeric Joint Sealants.
  7. C1021-08 Laboratories Engaged in Testing of Building Sealants.
  8. C1193-05 Standard Guide for Use of Joint Sealants.
  9. C1330-02 (R2007) Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.
  10. D1056-07 Specification for Flexible Cellular Materials—Sponge or Expanded Rubber.
  11. E84-08 Surface Burning Characteristics of Building Materials.
- C. Sealant, Waterproofing and Restoration Institute (SWRI).
1. 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-5:
1. ASTM C920, polyurethane or polysulfide.
  2. Type S.
  3. Class 25.
  4. Grade P.
  5. Shore hardness of 15-45.
- F. 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.
- G. 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.

- H. S-11:
  - 1. ASTM C920 polyurethane.
  - 2. Type M/S.
  - 3. Class 25.
  - 4. Grade P/NS.
  - 5. Shore A hardness of 35 to 50.

- I. S-12:
  - 1. ASTM C920, polyurethane.
  - 2. Type M/S.
  - 3. Class 25, joint movement range of plus or minus 50 percent.
  - 4. Grade P/NS.
  - 5. Shore A hardness of 25 to 50.

## **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 mortar joints.
- 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° F 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. Finish paving or floor joints flush unless joint is otherwise detailed.
9. Apply compounds with nozzle size to fit joint width.
10. 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 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field-test joint-sealant adhesion to joint substrates as recommended by sealant manufacturer:
  1. Extent of Testing: Test completed elastomeric sealant joints as follows:
    - a. Perform 10 tests for first 300 m (1000 feet) of joint length for each type of elastomeric sealant and joint substrate.
    - b. Perform one test for each 300 m (1000 feet) of joint length thereafter or one test per each floor per elevation.
- B. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements. Record results in a field adhesion test log.
- C. Inspect tested joints and report on following:
  1. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate.
  2. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
  3. Whether sealants filled joint cavities and are free from voids.
  4. Whether sealant dimensions and configurations comply with specified requirements.
- D. Record test results in a field adhesion test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
- E. Repair sealants pulled from test area by applying new sealants following same procedures used to originally seal joints. Ensure that original sealant surfaces are clean and new sealant contacts original sealant.
- F. Evaluation of Field Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements, will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

### 3.7 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.

### 3.8 LOCATIONS

- A. Exterior Building Joints, Horizontal and Vertical:
  - 1. Metal to Metal: Type S-1, S-2
  - 2. Metal to Masonry: Type S-1
  - 3. Threshold Setting Bed: Type S-1, S-3, S-4
- 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. Horizontal Traffic Joints:
  - 1. Concrete Paving: Type S-11 or S-12
- E. Interior Caulking:
  - 1. Typical Narrow Joint 6 mm, (1/4 inch) or less at Walls and Adjacent Components: Types C-1 and C-2.
  - 2. Perimeter of Doors, Windows, Access Panels which Adjoin Concrete or Masonry Surfaces: Types C-1 and C-2.
  - 3. Exposed Isolation Joints at Top of Full Height Walls: Types C-1 and C-2.
  - 4. Exposed Acoustical Joint at Sound Rated Partitions Type C-2.
  - 5. Concealed Acoustic Sealant Type S-4, C-1, and C-2.

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**SECTION 08 11 13**

**HOLLOW METAL DOORS AND FRAMES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies steel doors, steel frames and related components.
- B. Terms relating to steel doors and frames as defined in ANSI A123.1 and as specified.

**1.2 RELATED WORK**

- A. Frames fabricated of structural steel: Section 05 50 00, METAL FABRICATIONS.
- B. Aluminum frames entrance work: Section 08 41 13, ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS.
- C. Overhead doors including loading docks: Section 08 33 00, COILING DOORS AND GRILLES.
- D. Door Hardware: Section 08 71 00, DOOR HARDWARE.
- E. Card readers and biometric devices: Section 28 00 00, BASIC SECURITY REQUIREMENTS.
- F. Intrusion Alarm: Section 28 00 00, BASIC SECURITY REQUIREMENTS.
- G. Security Monitors: Section 28 00 00, BASIC SECURITY REQUIREMENTS.

**1.3 TESTING**

- A. An independent testing laboratory shall perform testing.

**1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturers Literature and Data:
  - 1. Fire rated doors and frames, showing conformance with NFPA 80 and Underwriters Laboratory, Inc., or Intertek Testing Services or Factory Mutual fire rating requirements.
  - 2. Sound rated doors, including test report from Testing Laboratory.

**1.5 SHIPMENT**

- A. Prior to shipment label each door and frame to show location, size, door swing and other pertinent information.
- B. Fasten temporary steel spreaders across the bottom of each door frame.

**1.6 STORAGE AND HANDLING**

- A. Store doors and frames at the site under cover.
- B. Protect from rust and damage during storage and erection until completion.

**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. Federal Specifications (Fed. Spec.):
  - 1. L-S-125B Screening, Insect, Nonmetallic
- C. Door and Hardware Institute (DHI):
  - 1. A115 Series Steel Door and Frame Preparation for Hardware, Series A115.1 through A115.17 (Dates Vary)
- D. Steel Door Institute (SDI):
  - 1. 113-01 Thermal Transmittance of Steel Door and Frame Assemblies
  - 2. 128-1997 Acoustical Performance for Steel Door and Frame Assemblies
  - 3. A250.8-03 Standard Steel Doors and Frames
- E. American Society for Testing and Materials (ASTM):
  - 1. A568/568-M-07 Steel, Sheet, Carbon, and High-Strength, Low-alloy, Hot-Rolled and Cold-Rolled
  - 2. A1008-08 Steel, sheet, Cold-Rolled, Carbon, Structural, High Strength Low Alloy and High Strength Low Alloy with Improved Formability
  - 3. D1621-04 Compressive Properties of Rigid Cellular Plastics
  - 4. D3656-07 Insect Screening and Louver Cloth Woven from Vinyl Coated Glass Yarns
  - 5. E90-04 Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions
- F. The National Association Architectural Metal Manufacturers (NAAMM):
  - 1. Metal Finishes Manual (1988 Edition)

- G. National Fire Protection Association (NFPA):
  - 1. 80-09 Fire Doors and Fire Windows
- H. Underwriters Laboratories, Inc. (UL):
  - 1. Fire Resistance Directory
- I. Intertek Testing Services (ITS):
  - 1. Certifications Listings...Latest Edition
- J. Factory Mutual System (FM):
  - 1. Approval Guide

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Sheet Steel: ASTM A1008, cold-rolled for panels (face sheets) of doors.
- B. Anchors, Fastenings and Accessories: Fastenings anchors, clips connecting members and sleeves from zinc coated steel.
- C. Insect Screening: ASTM D3656, 18 by 18 regular mesh.
- D. Prime Paint: Paint that meets or exceeds the requirements of SDI A250.8.

### **2.2 FABRICATION, GENERAL**

- A. GENERAL:
  - 1. Follow SDI A250.8 for fabrication of standard steel doors, except as specified otherwise. Doors to receive hardware specified in Section 08 71 00, DOOR HARDWARE. Tolerances as per SDI A250.8. Thickness, 44 mm (1-3/4 inches), unless otherwise shown.
  - 2. Close top edge of exterior doors flush and seal to prevent water intrusion.
  - 3. When vertical steel stiffeners are used for core construction, fill spaces between stiffeners with mineral fiber insulation.
- B. Heavy Duty Doors: SDI A250.8, Level 2, Model 2 of size and design shown. Core construction types a, d, or f, for interior doors, and, types b, c, e, or f, for exterior doors.
- C. Extra Heavy Duty Doors: SDI A250.8, Level 3, Model 2 of size and design shown. Core construction Types d or f, for interior doors, and Types b, c, e, or f, for exterior doors. Use for detention doors, stairwell doors and security doors. See additional requirements for detention doors, under paragraph "Custom Hollow Metal Doors.
- D. Fire Rated Doors (Labeled):
  - 1. Conform to NFPA 80 when tested by Underwriters Laboratories, Inc.,

Inchcape Testing Services, or Factory Mutual for the class of door or door opening shown.

2. Fire rated labels of metal, with raised or incised markings of approving laboratory shall be permanently attached to doors.
3. Close top and vertical edges of doors flush. Vertical edges shall be seamless. Apply steel astragal to the meeting stile of the active leaf of pairs of fire rated doors, except where vertical rod exit devices are specified for both leaves swinging in the same direction.
4. Construct fire rated doors in stairwell enclosures for maximum transmitted temperature rise of 230° C (450° F) above ambient temperature at end of 30 minutes of fire exposure when tested in accordance with ASTM E152.

### 2.3 METAL FRAMES

#### A. General:

1. SDI A250.8, 1.3 mm (0.053 inch) thick sheet steel, types and styles as shown or scheduled.
2. Frames for exterior doors: Fabricate from 1.7 mm (0.067 inch) thick galvanized steel conforming to ASTM A525.
3. Frames for labeled fire rated doors and windows.
  - a. Comply with NFPA 80. Test by Underwriters Laboratories, Inc., Inchcape Testing Services, or Factory Mutual.
  - b. Fire rated labels of approving laboratory permanently attached to frames as evidence of conformance with these requirements. Provide labels of metal or engraved stamp, with raised or incised markings.
4. Frames for doors specified to have automatic door operators; Security doors (Type 36); service window: minimum 1.7 mm (0.067 inch) thick.
5. Knocked-down frames are not acceptable.

#### B. Terminated Stops: SDI A250.8.

#### C. Two piece frames:

1. One piece unequal leg finished rough buck sub-frames as shown, drilled for anchor bolts.
2. Unequal leg finished frames formed to fit subframes and secured to subframe legs with countersunk, flat head screws, spaced 300 mm (12 inches) on center at head and jambs on each side.
3. Preassemble at factory for alignment.

#### D. Frame Anchors:

1. Floor anchors:
  - a. Where floor fills occur, provide extension type floor anchors to compensate for depth of fill.
  - b. At bottom of jamb use 1.3 mm (0.053 inch) thick steel clip angles welded to jamb and drilled to receive two 6 mm (1/4 inch) floor

- bolts. Use 50 mm x 50 mm (2 inch by 2 inch) 9 mm (3/8 inch) clip angle for lead lined frames, drilled for 9 mm (3/8 inch) floor bolts.
- c. Where mullions occur, provide 2.3 mm (0.093 inch) thick steel channel anchors, drilled for two 6 mm (1/4 inch) floor bolts and frame anchor screws.
  - d. Where sill sections occur, provide continuous 1 mm (0.042 inch) thick steel rough bucks drilled for 6 mm (1/4 inch) floor bolts and frame anchor screws. Space floor bolts at 50 mm (2 inches) on center.
2. Jamb anchors:
- a. Locate anchors on jambs near top and bottom of each frame, and at intermediate points not over 600 mm (24 inches) apart, except for fire rated frames space anchors as required by labeling authority.
  - b. Form jamb anchors of not less than 1 mm (0.042 inch) thick steel unless otherwise specified.
  - c. Anchors set in masonry: Use adjustable anchors designed for friction fit against the frame and for extension into the masonry not less than 250 mm (10 inches). Use one of following type:
    - 1) Wire loop type of 5 mm (3/16 inch) diameter wire.
    - 2) T-shape or strap and stirrup type of corrugated or perforated sheet steel.
  - d. Anchors for stud partitions: Either weld to frame or use lock-in snap-in type. Provide tabs for securing anchor to the sides of the studs.
  - e. Anchors for frames set in prepared openings:
    - 1) Steel pipe spacers with 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.
    - 2) Drill jamb stop and strap spacers for 6 mm (1/4 inch) flat head bolts to pass thru frame and spacers.
    - 3) Two piece frames: Subframe or rough buck drilled for 6 mm (1/4 inch) bolts.
  - f. Anchors for observation windows and other continuous frames set in stud partitions.
    - 1) In addition to jamb anchors, weld clip anchors to sills and heads of continuous frames over 1200 mm (4 feet) long.
    - 2) Anchors spaced 600 mm (24 inches) on centers maximum.
  - g. Modify frame anchors to fit special frame and wall construction and provide special anchors where shown or required.

## 2.4 LOUVERS

### A. General:

- 1. Sight proof type with stationary blades the full thickness of the door.
- 2. Design lightproof louvers to exclude passage of light but permit free ventilation.

3. Provide insect screen and wire guards at exterior doors, except where doors are located below completely enclosed areaways, the wire guard is not required.

B. Fabrication:

1. Steel louvers 0.8 mm (0.032 inch) thick for interior doors, and 1.3 mm (0.053 inch) inch thick for exterior doors.
2. Fabricate louvers as complete units. Install in prepared cutouts in doors.
3. Weld stationary blades to frames. Weld louvers into door openings.

C. Screen frames:

1. Frame of either extruded aluminum or tubular aluminum.
2. Fabricate frame to hold wire fabric in a channel with a retaining bar anchor and to mount on surface of door with screws.
3. Do not lap frame over louver opening.
4. Miter corners of frame members and join by concealed mechanical fastenings extending about 57 mm (2-1/4 inches) into ends of each member.
5. Drill frame and doors for screw attachment. Space screws 50 mm (2 inches) from end of each leg of frame and not over 300 mm (12 inches) on center between end screws.
6. Finish: Clear anodized finish, 0.4 mils thick.
7. Insect Screens: Fasten insect screens to interior side of doors with retaining bar against door and not exposed to view.
8. Wire Guards:
  - a. Wire fabric shall be wire guard screen as specified.
  - b. Fasten wire guard to exterior side of door with retaining bar against door and not exposed to view.

**2.5 SHOP PAINTING**

- A. SDI A250.8.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Plumb, align and brace frames securely 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 if the shipping spreader is removed.
  3. Protect frame from accidental abuse.
  4. Where construction will permit concealment, leave the shipping

spreaders in place after installation, otherwise remove the spreaders after the frames are set and anchored.

5. Remove wood spreaders and braces only after the walls are built and jamb anchors are secured.

B. Floor Anchors:

1. Anchor the bottom of door frames to floor with two 6 mm (1/4 inch) diameter expansion bolts. Use 9 mm (3/8 inch) bolts on lead lined frames.
2. Power actuated drive pins may be used to secure frame anchors to concrete floors.

C. Jamb Anchors:

1. Anchors in masonry walls: Embed anchors in mortar. Fill space between frame and masonry wall with grout or mortar as walls are built.
2. Coat frame back with a bituminous coating prior to lining of grout filling in masonry walls.
3. Secure anchors to sides of studs with two fasteners through anchor tabs. Use steel drill screws to steel studs.
4. Frames set in prepared openings of masonry or concrete: Expansion bolt to wall with 6 mm (1/4 inch) expansion bolts through spacers. Where subframes or rough bucks are used, 6 mm (1/4 inch) expansion bolts on 600 mm (24 inch) centers or power activated drive pins 600 mm (24 inches) on centers. Secure two piece frames to subframe or rough buck with machine screws on both faces.

- D. Install anchors for labeled fire rated doors to provide rating as required.

- E. Frames for Sound Rated Doors: Coordinate to line frames for sound rated doors with insulation.

**3.2 INSTALLATION OF DOORS AND APPLICATION OF HARDWARE**

- A. Install doors and hardware as specified in Sections Section 08 71 00, DOOR HARDWARE .

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**SECTION 08 14 00**

**INTERIOR WOOD DOORS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies interior flush doors with prefinish, prefit option.
- B. Section includes fire rated doors, sound retardant doors, and smoke doors.

**1.2 RELATED WORK**

- A. Metal door frames: Section 08 11 13, HOLLOW METAL DOORS AND FRAMES.
- B. Overhead doors including loading docks: Section 08 33 00, COILING DOORS AND GRILLES.
- C. Door hardware including hardware location (height): Section 08 71 00, DOOR HARDWARE.
- D. Installation of doors and hardware: Section 08 71 00, DOOR HARDWARE.
- E. Finish: Section 09 06 00, SCHEDULE FOR FINISHES.
- F. Metal louvers: Section 08 90 00, LOUVERS AND VENTS.
- G. Card readers and biometric devices: Section 28 00 00, BASIC SECURITY REQUIREMENTS
- H. Intrusion alarm: Section 28 00 00, BASIC SECURITY REQUIREMENTS
- I. Security monitors: Section 28 00 00, BASIC SECURITY REQUIREMENTS

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. 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.
  - 2. Veneer sample 200 mm (8 inch) by 275 mm (11 inch) by 6 mm (1/4 inch) showing specified wood species sanded to receive a transparent finish. Factory finish veneer sample where the prefinished option is accepted.
- C. Shop Drawings:

1. Show every door in project and schedule location in building.
2. Indicate type, grade, finish and size; include detail of glazing, louvers, sound gasketing, and pertinent details.
3. Provide information concerning specific requirements not included in the manufacturer's literature and data submittal.

D. Manufacturer's Literature and Data:

1. Sound rated doors, including test report indicating STC rating per ASTM E90 from test laboratory.
2. Labeled fire rated doors showing conformance with NFPA 80.

E. Laboratory Test Results:

1. Screw holding capacity test report in accordance with WDMA T.M.10.
2. Split resistance test report in accordance with WDMA T.M.5.
3. Cycle/Slam test report in accordance with WDMA T.M.7.
4. Hinge-Loading test report in accordance with WDMA T.M.8.

#### 1.4 WARRANTY

- A. Doors are subject to terms of Article titled "Warranty of Construction", FAR clause 52.246-21, except that warranty shall be as follows:
1. For interior doors, manufacturer's warranty for lifetime of original installation.
  2. Specified STC RATING for sound retardant rated door assembly in place.

#### 1.5 DELIVERY AND STORAGE

- A. Factory seal doors and accessories in minimum of 6 mill polyethylene bags or cardboard packages which shall remain unbroken during delivery and storage.
- B. Store in accordance with WDMA I.S.1-A, J-1 Job Site Information.
- C. Label package for door opening where used.

#### 1.6 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. Window and Door Manufacturers Association (WDMA):
1. I.S.1-A-04 Architectural Wood Flush Doors
  2. I.S.4-07A Water-Repellent Preservative Non-Pressure Treatment for Millwork
  3. I.S.6A-01 Architectural Wood Stile and Rail Doors
  4. T.M.5-90 Split Resistance Test Method

5. T.M.6-08 Adhesive (Glue Bond) Durability Test Method
  6. T.M.7-08 Cycle-Slam Test Method
  7. T.M.8-08 Hinge Loading Test Method
  8. T.M.10-08 Screwholding Test Method
- C. National Fire Protection Association (NFPA):
1. 80-07 Protection of Buildings from Exterior Fire
  2. 252-08 Fire Tests of Door Assemblies
- D. ASTM International (ASTM):
1. E90-04 Laboratory Measurements of Airborne Sound Transmission Loss

## **PART 2 - PRODUCTS**

### **2.1 FLUSH DOORS**

- A. General:
1. Meet requirements of WDMA I.S.1-A, Extra Heavy Duty.
  2. Adhesive: Type II
  3. Thickness: 45 mm (1-3/4 inches) unless otherwise shown or specified.
- B. Face Veneer:
1. In accordance with WDMA I.S.1-A.
  2. For transparent finishes:
    - a. Wood Veneer Species and Cut: Types as specified in Section 06 20 00, FINISH CARPENTRY:
      - 1) Type WV1 - Maple, quartered.
      - 2) Type WV2 - Cherry, quartered.
    - b. Match between Veneer Leaves: Book match.
    - c. Assembly of Veneer Leaves on Door Faces: Center-balance match.
    - d. Pair and Set Match: Provide for doors hung in same opening.
    - e. Room Match: Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 20 feet (6 m) or more.
    - f. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.
    - g. Blueprint Match: Where indicated, provide doors with faces produced from same flitches as adjacent wood paneling and arranged to provide blueprint match with wood paneling. Comply with requirements in Section 06 20 00, FINISH CARPENTRY.
    - h. Exposed Vertical and Top Edges: Same species as faces or a compatible species.
    - i. Core: Particleboard.
    - j. Construction: Five plies. Stiles and rails are bonded to core,

- then entire unit abrasive planed before veneering. Faces are bonded to core using a hot press.
- k. Match face veneers for doors for uniform effect of color and grain at joints.
  - l. Door edges shall be same species or comparable species as door face veneer.
3. For painted finishes: Custom Grade, mill option close grained hardwood, premium or medium density overlay. Do not use Lauan.
  4. Factory sand doors for finishing.
- C. Wood for stops, louvers, muntins and moldings of flush doors required to have transparent finish:
1. Solid Wood of same species as face veneer, except maple may be used on birch doors.
  2. Glazing:
    - a. On non-labeled doors use applied wood stops nailed tight on room side and attached on opposite side with flathead, countersunk wood screws, spaced approximately 125 mm (5 inches) on centers.
- D. Fire rated wood doors:
1. Fire Performance Rating:
    - a. "B" label, 1-1/2 hours.
    - b. "C" label, 3/4 hour.
  2. Labels:
    - a. Doors shall conform to the requirements of ASTM E2074, or NFPA 252, and, carry an identifying label from a qualified testing and inspection agency for class of door or opening shown designating fire performance 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 T.M.8. Average of 10 test samples for Extra Heavy Duty doors.
    - b. Direct screw withdrawal: WDMA T.M.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 in accordance with WDMA T.M.7.
  4. Additional 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 shall measure not less than 125 mm (five inches) minimum by full core width.
    - d. Reinforcement blocking in compliance with manufacturer's labeling requirements.
    - e. Mineral material similar to core is not acceptable.

5. Other Core Components: Manufacturer's standard as allowed by the labeling requirements.
  6. Provide steel frame approved for use in labeled doors for vision panels.
  7. Provide steel astragal on pair of doors.
- E. Smoke Barrier Doors:
1. For glazed openings use steel frames approved for use in labeled doors.
  2. Provide a metal astragal on one leaf of pairs of doors, including double egress doors.
- F. Sound Rated Doors:
1. Fabricated as specified for flush wood doors with additional construction requirements to meet specified sound transmission class (STC).
  2. STC Rating of the door assembly in place when tested in accordance with ASTM E90 by an independent nationally recognized acoustical testing laboratory not less than 36 [\_\_\_\_\_].
  3. Accessories:
    - a. Frame Gaskets: Continuous closed cell sponge neoprene with stop adjusters.
    - b. Automatic Door Bottom Seal:
      - 1) Steel spring operated, closed cell sponge neoprene metal mounted removable in extruded aluminum housing with a medium matte 0.1 mm (4.0 mil) thick clear Anodized finish.
      - 2) Concealed or Surface Mounted.

## 2.2 PREFINISH, PREFIT OPTION

- A. Flush doors may be factory machined to receive hardware, bevels, undercuts, cutouts, accessories and fitting for frame.
- B. Factory fitting to conform to specification for shop and field fitting, including factory application of sealer to edge and routings.
- C. Flush doors to receive transparent finish (in addition to being prefit )shall be factory finished as follows:
  1. WDMA I.S.1-A Section F-3 specification for System TR-4, Conversion Varnish or System TR-5, Catalyzed Vinyl.
  2. Use stain when required to produce the finish specified in Section 09 06 00 SCHEDULE FOR FINISHES.

## 2.3 IDENTIFICATION MARK

- A. On top edge of door.
- B. Either a stamp, brand or other indelible mark, giving manufacturer's name, door's trade name, construction of door, code date of manufacture and quality.

- C. Accompanied by either of the following additional requirements:
  - 1. An identification mark or a separate certification including name of inspection organization.
  - 2. Identification of standards for door, including glue type.
  - 3. Identification of veneer and quality certification.
  - 4. Identification of preservative treatment for stile and rail doors.

#### **2.4 SEALING:**

- A. Give top and bottom edge of doors two coats of catalyzed polyurethane or water resistant sealer before sealing in shipping containers.

### **PART 3 - EXECUTION**

#### **3.1 DOOR PREPARATION**

- A. Field, shop or factory preparation: Do not violate the qualified testing and inspection agency label requirements for fire rated doors.
- B. Clearances between Doors and Frames and Floors:
  - 1. 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. Maximum clearance at bottom of sound rated doors, light-proofed doors, doors to operating rooms, and doors designated to be fitted with mechanical seal: 10 mm (3/8 inch).
- C. Provide cutouts for special details required and specified.
- D. Rout doors for hardware using templates and location heights specified in Section, 08 71 00 DOOR HARDWARE.
- E. 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.
- F. Immediately after fitting and cutting of doors for hardware, seal cut edges of doors with two coats of water resistant sealer.
- G. Finish surfaces, including both faces, top and bottom and edges of the doors smooth to touch.
- H. Apply a steel astragal on the opposite side of active door on pairs of fire rated doors.
- I. Apply a steel astragal to meeting style of active leaf of pair of doors or double egress smoke doors.

#### **3.2 INSTALLATION OF DOORS APPLICATION OF HARDWARE**

- A. Install doors and hardware as specified in Section, INSTALLATION OF DOORS

AND HARDWARE.

**3.3 DOOR PROTECTION**

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

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**SECTION 08 41 13**

**ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies aluminum entrance work including hung doors, designed and constructed for blast hazard mitigation.

**1.2 RELATED WORK**

- A. Window Walls: Section 08 44 13, GLAZED ALUMINUM CURTAIN WALLS.
- B. Tension-cable supported, point-supported Glazed Curtain Walls: Section 08 44 26.23, Specialty Glazed-Structural Assemblies.
- C. Glass and Glazing: Section 08 80 00, GLAZING.
- D. Hardware: Section 08 71 00, DOOR HARDWARE.
- E. Automatic Door Operators: Section 08 71 13, AUTOMATIC DOOR OPERATORS.
- F. Texture and color of finish: Section 09 06 00, SCHEDULE FOR FINISHES.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings: (1/2 full scale) showing construction, anchorage, reinforcement, and installation details.
- C. Manufacturer's Literature and Data:
1. Doors, each type.
- D. Samples:
1. Door corner section, 450 mm x 450 mm (18 x 18 inches), of each door type specified, showing vertical and top hinge edges internal reinforcement.
  2. Two samples of organic finish of each color specified.
- E. Manufacturer's Certificates:
1. Indicating manufacturer's qualifications specified.

**1.4 QUALITY ASSURANCE**

- A. Approval by Contracting Officer is required of products of proposed manufacturer, or supplier, and will be based upon submission by Contractor

certification.

- B. Certify manufacturer regularly and presently manufactures aluminum entrances and storefronts as one of their principal products.

#### **1.5 DELIVERY, STORAGE AND HANDLING**

- A. Deliver aluminum entrance and storefront material to the site in packages or containers; labeled for identification with the manufacturer's name, brand and contents.
- B. Store aluminum entrance and storefront material in weather-tight and dry storage facility.
- C. Protect from damage from handling, weather and construction operations before, during and after installation.

#### **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):
  - 1. B209-06 Aluminum and Aluminum-Alloy Sheet and Plate
  - 2. B221-05 Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
  - 3. E283-04 Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
  - 4. E331-00 Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
  - 5. F468-06 Nonferrous Bolts, Hex Cap Screws, and Studs for General Use
  - 6. F593-04 Stainless Steel Bolts, Hex Cap Screws, and Studs
- C. National Association of Architectural Metal Manufacturers (NAAMM):
  - 1. AMP 500 Series Metal Finishes Manual
- D. American Architectural Manufacturer's Association (AAMA):
  - 1. 2604-05 High Performance Organic Coatings on Architectural Aluminum Extrusions and Panels
- E. American Welding Society (AWS):
  - 1. D1.2-03 Structural Welding Code Aluminum

#### **1.7 PERFORMANCE REQUIREMENTS**

- A. Shapes and thickness of framing members shall be sufficient to withstand a design wind load of not less than 1.4 kPa (30 pounds per square foot)

of supported area with a deflection of not more than 1/175 times the length of the member and a safety factor of not less than 1.65 (applied to overall load failure of the unit). Provide glazing beads, moldings, and trim of not less than 1.25 mm (0.050 inch) nominal thickness.

- B. Air Infiltration: When tested in accordance with ASTM E 283, air infiltration shall not exceed 2.63 x 10<sup>-5</sup> cm per square meter (0.06 cubic feet per minute per square foot) of fixed area at a test pressure of 0.30 kPa (6.24 pounds per square foot) 80 kilometers (50 mile) per hour wind.
- C. Water Penetration: When tested in accordance with ASTM E 331, there shall be no water penetration at a pressure of 0.38 kPa (8 pounds per square foot) of fixed area.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Aluminum, ASTM B209 and B221:
  - 1. Alloy 6063 temper T5 for doors, door frames.
  - 2. Alloy 6061 temper T6 for guide tracks for sliding doors and other extruded structural members.
  - 3. For color anodized finish, use aluminum alloy as required to produce specified color.
- B. Fasteners:
  - 1. Aluminum: ASTM F468, Alloy 2024.
  - 2. Stainless Steel: ASTM F593, Alloy Groups 1, 2 and 3.

### **2.2 FABRICATION**

- A. Fabricate doors, of extruded aluminum sections not less than 3 mm (0.125 inch) thick. Fabricate glazing beads of aluminum not less than 1.0 mm (0.050 inch) thick.
- B. Accurately form metal parts and accurately fit and rigidly assemble joints, except those joints designed to accommodate movement. Seal joints to prevent leakage of both air and water.
- C. Make welds in aluminum in accordance with the recommended practice AWA D1.2. Use electrodes and methods recommended by the manufacturers of the metals and alloys being welded. Make welds behind finished surfaces so as to cause no distortion or discoloration of the exposed side. Clean welded joints of welding flux and dress exposed and contact surfaces.
- D. Make provisions in doors and frames to receive the specified hardware and accessories. Coordinate schedule and template for hardware specified under Section 08 71 00, DOOR HARDWARE. Where concealed closers or other mechanisms are required, provide the necessary space, cutouts, and reinforcement for secure fastening.

- E. Fit and assemble the work at the manufacturer's plant. Mark work that cannot be permanently plant-assembled to assure proper assembly in the field.

### **2.3 PROTECTION OF ALUMINUM**

- A. Isolate aluminum from contact with dissimilar metals other than stainless steel, white bronze, or zinc by any of the following:
  - 1. Coat the dissimilar metal with two coats of heavy-bodied alkali resistant bituminous paint.
  - 2. Place caulking compound, or non-absorptive tape, or gasket between the aluminum and the dissimilar metal.
  - 3. Paint aluminum in contact with mortar, concrete and plaster, with a coat of aluminum paint primer.

### **2.4 FRAMES**

- A. Fabricate doors, frames, mullions, transoms, frames for fixed glass and similar members from extruded aluminum not less than 3 mm (0.125 inch) thick.
- B. Provide integral stops and glass rebates and applied snap-on type trim.
- C. Use concealed screws, bolts and other fasteners. Secure cover boxes to frames in back of all lock strike cutouts.
- D. Fabricate framework with thermal breaks in frames where insulating glass is scheduled and specified under Section 08 80 00, GLAZING.

### **2.5 STILE AND RAIL DOORS**

- A. Nominal 45 mm (1-3/4 inch) thick, with stile and head rail 90 mm (3-1/2 inches) wide, and bottom rail 250 mm (10 inches) wide.
- B. Bevel single-acting doors 3 mm (1/8 inch) at lock, hinge and meeting stile edges. Provide clearances of 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. Form glass rebates integrally with stiles and rails. Glazing beads may be formed integrally with stiles and rails or applied type secured with fasteners at 150 mm (6 inches) on centers.
- C. Construct doors with a system of welded joints or interlocking dovetail joints between stiles and rails. Clamp door together through top and bottom rails with 9 mm (3/8 inch) primed steel rod extending into the stiles, and having a self-locking nut and washer at each end. Reinforce stiles and rails to prevent door distortion when tie rods are tightened. Provide a compensating spring-type washer under each nut to take up any stresses that may develop. Construct joints between rails and stiles to remain rigid and tight when door is operated.
- D. Weather-stripping: Provide removable, woven pile type (silicone-treated) weather-stripping attached to aluminum or vinyl holder. Make slots for applying weather-stripping integral with doors and door frame stops. Apply continuous weather-stripping to heads, jambs, bottom, and meeting stiles

of doors and frames. Install weather-stripping so doors can swing freely and close positively.

## **2.6 REINFORCEMENT FOR BUILDERS HARDWARE**

- A. Fabricate from stainless steel plates.
- B. Hinge and pivot reinforcing: 4.55 mm (0.1793 inch) thick.
- C. Reinforcing for lock face, flush bolts, concealed holders, concealed or surface mounted closers: 2.66 mm (0.1046 inch) thick.
- D. Reinforcing for all other surface mounted hardware: 1.5 mm (0.0598 inch) thick.

## **2.7 FINISH**

- A. In accordance with NAAMM AMP 500 series.
- B. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Allowable Installation Tolerances: Install work plumb and true, in alignment and in relation to lines and grades shown. Variation of 3 mm (1/8 inch) in 2400 mm (8 feet), non-accumulative, is maximum permissible for plumb, level, warp, bow and alignment.
- B. Anchor aluminum frames to adjoining construction at heads, jambs and bottom and to steel supports, and bracing. Anchor frames with stainless steel or aluminum countersunk flathead, expansion bolts or machine screws, as applicable. Use aluminum clips for internal connections of adjoining frame sections.
- C. Where work is installed within masonry or concrete openings, place no parts other than built-in anchors and provision for operating devices located in the floor, until after the masonry or concrete work is completed.
- D. Install hardware specified under Section 08 71 00, DOOR HARDWARE.
- E. Install hung door operators specified under Section 08 71 13, AUTOMATIC DOOR OPERATORS.

### **3.2 ADJUSTING**

- A. After installation of entrance and storefront work is completed, adjust and lubricate operating mechanisms to insure proper performance.

**3.3 PROTECTION, CLEANING AND REPAIRING**

- A. Remove all mastic smears and other unsightly marks, and repair any damaged or disfiguration of the work. Protect the installed work against damage or abuse.

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**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 17 10, INTEGRATED DOOR ASSEMBLIES Section 08 41 13, ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS Section 08 33 00, COILING DOORS AND GRILLES Section 08 71 13, AUTOMATIC DOOR OPERATORS .
- C. Finishes: Section 09 06 00, SCHEDULE FOR FINISHES.
- D. Painting: Section 09 91 00, PAINTING.
- E. Card Readers: Section 28 13 11, PHYSICAL ACCESS CONTROL SYSTEMS.
- F. Electrical: Division 26, ELECTRICAL.
- G. Fire Detection: Section 28 31 00, FIRE DETECTION AND ALARM.

**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, if possible, 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 52.24-21, 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.

**1.6 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES. Submit 6 copies of the schedule per Section 01 33 23 plus 2 copies to the VAMC Locksmith (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 Resident Engineer for reference purposes. Tag shall identify items by Project Specification number and manufacturer's catalog number. These items shall remain on file in Resident Engineer's office until all other similar items have been installed in project, at which time the Resident Engineer 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 "HW" followed by a number. Each number designates a set of hardware items applicable to a door type.

- B. Manufacturers' Catalog Number References: Where manufacturers' products are specified herein, products of other manufacturers which are considered equivalent to those specified may be used. Manufacturers whose products are specified are identified by abbreviations as follows:

Adams-Rite	Adams Rite Mfg. Co.	Pomona, CA
Best	Best Access Systems	Indianapolis, IN
Don-Jo	Don-Jo Manufacturing	Sterling, MA
G.E. Security	GE Security, Inc.	Bradentown, FL
Markar	Markar Architectural Products	Pomona, CA
Pemko	Pemko Manufacturing Co.	Ventura, CA
Rixson	Rixson	Franklin Park, IL
Rockwood	Rockwood Manufacturing Co.	Rockwood, PA
Securitron	Securitron Magnalock Corp.	Sparks, NV
Southern Folger	Southern Folger Detention Equipment Co.	San Antonio, TX
Stanley	The Stanley Works	New Britain, CT
Tice	Tice Industries	Portland, OR
Trimco	Triangle Brass Mfg. Co.	Los Angeles, CA
Zero	Zero Weather Stripping Co.	New York, NY

- C. Keying: All cylinders shall be keyed into existing 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 Resident Engineer.

#### 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):
1. F883-04 Padlocks
  2. 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):
1. A156.1-06 Butts and Hinges
  2. A156.2-03 Bored and Pre-assembled Locks and Latches
  3. A156.3-08 Exit Devices, Coordinators, and Auto Flush Bolts
  4. A156.4-08 Door Controls (Closers)
  5. A156.5-01 Auxiliary Locks and Associated Products

6. A156.6-05 Architectural Door Trim
  7. A156.8-05 Door Controls-Overhead Stops and Holders
  8. A156.12-05 Sliding and Folding Door Hardware
  9. A156.13-05 Mortise Locks and Latches Series 1000
  10. A156.15-06 Release Devices-Closer Holder, Electromagnetic and Electromechanical
  11. A156.16-08 Auxiliary Hardware
  12. A156.17-04 Self-Closing Hinges and Pivots
  13. A156.18-06 Materials and Finishes
  14. A156.20-06 Strap and Tee Hinges, and Hasps
  15. A156.21-09 Thresholds
  16. A156.22-05 Door Gasketing and Edge Seal Systems
  17. A156.23-04 Electromagnetic Locks
  18. A156.24-03 Delayed Egress Locking Systems
  19. A156.25-07 Electrified Locking Devices
  20. A156.26-06 Continuous Hinges
  21. A156.28-07 Master Keying Systems
  22. A156.29-07 Exit Locks and Alarms
  23. A156.30-03 High Security Cylinders
  24. A156.31-07 Electric Strikes and Frame Mounted Actuators
  25. A250.8-03 Standard Steel Doors and Frames
- D. National Fire Protection Association (NFPA):
1. 80-10 Fire Doors and Fire Windows
  2. 101-09 Life Safety Code
- E. Underwriters Laboratories, Inc. (UL):
1. 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 A5112 for doors 900 mm (3 feet) wide or less and Type 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 CONTINUOUS HINGES

- A. ANSI/BHMA A156.26, Grade 1-600.
1. Listed under Category N in BHMA's "Certified Product Directory."
- B. General: Minimum 0.120 inch (3.0 mm) thick, hinge leaves with minimum overall width of 4 inches (102 mm); fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete:
- C. Continuous, Barrel-Type Hinges: Hinge with knuckles formed around a Teflon-coated 6.35 mm (0.25-inch) minimum diameter pin that extends entire length of hinge.
1. Base Metal for Exterior Hinges: Stainless steel.
  2. Base Metal for Interior Hinges: Steel.
  3. Base Metal for Hinges for Fire-Rated Assemblies: Steel.
  4. Provide with non-removable pin (hospital tip option) at lockable outswing doors.
  5. Where required to clear adjacent casing, trim, and wall conditions and allow full door swing, provide wide throw hinges of minimum width required.

6. Provide with manufacturer's cut-outs for separate mortised power transfers and/or mortised automatic door bottoms where they occur.
7. Where thru-wire power transfers are integral to the hinge, provide hinge with easily removable portion to allow easy access to wiring connections.
8. Where models are specified that provide an integral wrap-around edge guard for the hinge edge of the door, provide manufacturer's adjustable threaded stud and machine screw mechanism to allow the door to be adjusted within the wrap-around edge guard.

### **2.3 DOOR CLOSING DEVICES**

- A. Closing devices shall be products of one manufacturer for each type specified.

### **2.4 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.

## **2.5 FLOOR CLOSERS AND FLOOR PIVOT SETS**

- A. Comply with ANSI A156.4. Provide stainless steel floor plates for floor closers and floor pivots, except where metal thresholds occur. Provide cement case for all floor closers. Floor closers specified for fire doors shall comply with Underwriters Laboratories, Inc., requirements for concealed type floor closers for classes of fire doors indicated on drawings. Hold-open mechanism, where required, shall engage when door is opened 105 degrees, except when door swing is limited by building construction or equipment, the hold-open feature shall engage when door is opened approximately 90 degrees. The hold-open mechanism shall be selectable on/off by turning a screw through the floor plate. Floor closers shall have adjustable hydraulic back-check, adjustable close speed, and adjustable latch speed. Provide closers with delayed action where a hold-open mechanism is not required. Floor closers shall be multi-sized. Single acting floor closers shall also have built in dead stop. Where required, provide closers with special cement cases appropriate for shallow deck installation or where concrete joint lines run through the floor blockout. At offset-hung doors installed in deep reveals, provide special closer arm and spindle to allow for installation. Where stone or terrazzo is applied over the floor closer case, provide closer without floor plate and with extended spindle (length as required) and special cover pan (depth as required) to allow closer to be accessed without damaging the material applied over the closer. Pivots for non-labeled doors shall be cast, forged or extruded brass or bronze.
- B. Where floor closer appears in hardware set provide the following as applicable.
  1. Double Acting Floor Closers: Type C06012.
  2. Single Acting Floor Closer: Type C06021 (center pivoted). (Intermediate pivot is not required).
  3. Single Acting Floor Closers: Type C06041 (offset pivoted).
  4. Single Acting Floor Closer for Labeled Fire Doors: Type C06051 (offset pivoted).
  5. Single Acting Floor Closers For Lead Lined Doors: Type C06071 (offset pivoted).

## **2.6 COMBINATION CLOSER - HOLDER**

- A. Conform to ANSI A156.15; combination closer-holder with built-in electronic release.
- B. Combination closer-holder shall have the following features:

1. Control door closing and latching sequence by hydraulic action.
2. Wiring for 24V DC current. Current draw shall not exceed 0.16 amperes.
3. Combination closer-holder type:
  - a. At doors with 90-110° hold-open point: Single lever arm with slide track closing action, and adjustable hydraulic back-check. Provide tracks with spring-cushion stop assemblies to avoid the necessity of a separate wall or floor stop. Provide with double egress arm where required.
  - b. At doors with over 110° to 175° hold-open point: Single or double lever arm and adjustable hydraulic back-check. Provide with long arms where required for deep frame reveals.
4. Spring power for closing force shall conform to ANSI A156.4 and have 50% spring power adjustment.
5. Hold open mechanism shall hold door open between 85 degrees and 175 degrees depending on wall and frame conditions. Mount device to provide maximum door opening permitted by building construction or equipment.
6. Electronic release shall release door when signaled by smoke detector. Smoke detectors shall not be incorporated as an integral part of door holders. Smoke detectors are specified in the ELECTRICAL Section.
7. All closers to have full covers.
8. All closers shall have a 1 ½" minimum piston diameter and an adjustable back check position valve.

## 2.7 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).

## **2.8 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.

## **2.9 FLOOR DOOR HOLDERS**

- A. Conform to ANSI Standard A156.16. Provide extension strikes for Types L01301 and L01311 holders where necessary.

## **2.10 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 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 1. All locksets and latchsets shall have lever handles fabricated from cast stainless steel. Provide sectional (lever x rose) curved-return lever design matching Sargent "P" Lever. No substitute lever design or 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.)
  3. Auxiliary locks shall be as specified under hardware sets and conform to ANSI A156.5.
  4. Privacy locks in patient rooms shall have an inside thumbturn for privacy and an outside thumbturn for emergency entrance. Single occupancy patient privacy doors shall typically swing out; where such doors cannot swing out, provide center-pivoted doors with rescue hardware (see HW-2B).

#### **2.11 ELECTROMAGNETIC LOCKS**

- A. ANSI/BHMA A156.23; electrically powered, of strength and configuration indicated; with electromagnet attached to frame and armature plate attached to door. Listed under Category E in BHMA's "Certified Product Directory."
1. Type: Full exterior or full interior, as required by application indicated.
  2. Strength Ranking: 1500 lbf (6672 N).
  3. Inductive Kickback Peak Voltage: Not more than 0 V.
  4. Residual Magnetism: Not more than 0 lbf (0 N) to separate door from magnet.

- B. Delayed-Egress Locks: BHMA A156.24. Listed under Category G in BHMA's "Certified Product Directory".
1. Means of Egress Doors: Lock releases within 15 seconds after applying a force not more than 15 lbf (67 N) for not more than 3 seconds, as required by NFPA 101.
  2. Security Grade: Activated from secure side of door by initiating device.
  3. Movement Grade: Activated by door movement as initiating device.
  4. The lock housing shall not project more than 4-inches (101mm) from the underside of the frame head stop.

#### 2.12 ELECTRIC STRIKES

- A. ANSI/ BHMA A156.31 Grade 1.
- B. General: Use fail-secure electric strikes at fire-rated doors.

#### 2.13 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

#### 2.14 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.
4. Armor plates for doors are listed under Article "Hardware Sets". Armor plates shall be thickness as noted in the hardware set, 875 mm (35 inches) high and 38 mm (1-1/2 inches) less than width of doors, except on pairs of metal doors. Provide armor plates beveled on all 4 edges (B4E). Plates on pairs of metal doors shall be 25 mm (1 inch) less than width of each door. Where top of intermediate rail of door is less than 875 mm (35 inches) from door bottom, extend armor plates to within 13 mm (1/2 inch) of top of intermediate rail. On doors equipped with panic devices, extend armor plates to within 13 mm (1/2 inch) of panic bolt push bar.
5. Where louver or grille occurs in lower portion of doors, substitute stretcher plate and kick plate in place of armor plate. Size of stretcher plate and kick plate shall be 254 mm (10 inches) high.
6. Provide stainless steel edge guards where so specified at wood doors. Provide mortised type instead of surface type except where door construction and/or ratings will not allow. Provide edge guards of bevel and thickness to match wood door. Provide edge guards with factory cut-outs for door hardware that must be installed through or extend through the edge guard. Provide full-height edge guards except where door rating does not allow; in such cases, provide edge guards to height of bottom of typical lockset armor front. Forward edge guards to wood door manufacturer for factory installation on doors.

#### **2.15 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. Surface vertical rod panics shall only be provided less bottom rod; provide fire pins as required by exit device and door fire labels. Do not provide surface vertical rod panics at exterior doors.
- C. 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.
- D. Where removable mullions are specified at pairs with rim panic devices, provide mullion with key-removable feature.

- E. At non-rated openings with panic hardware, provide panic hardware with key cylinder dogging feature.
- F. Exit devices for fire doors shall comply with Underwriters Laboratories, Inc., requirements for Fire Exit Hardware. Submit proof of compliance.

**2.16 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).

**2.17 FLUSH BOLTS (AUTOMATIC)**

- A. Conform to ANSI A156.16. 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.

**2.18 DOOR PULLS**

- A. Conform to ANSI A156.6. Pull plate 90 mm by 350 mm (3-1/2 inches by 14 inches), unless otherwise specified. Cut plates of door pulls for cylinders, or turn pieces where required.

**2.19 PUSH PLATES**

- A. Conform to ANSI A156.6. Metal, Type J302, 200 mm (8 inches) wide by 350 mm (14 inches) high. Provide metal Type J300 plates 100 mm (4 inches) wide by 350 mm (14 inches) high where push plates are specified for doors with stiles less than 200 mm (8 inches) wide. Cut plates for cylinders, and turn pieces where required.

**2.20 COMBINATION PUSH AND PULL PLATES**

- A. Conform to ANSI 156.6. Type J303, stainless steel 3 mm (1/8 inch) thick, 80 mm (3-1/3 inches) wide by 800 mm (16 inches) high, top and bottom edges shall be rounded. Secure plates to wood doors with 38 mm (1-1/2 inch) long No. 12 wood screws. Cut plates for turn pieces, and cylinders where required. Pull shall be mounted down.

**2.21 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.

**2.22 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 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) from fame face.

**2.23 AUTOMATIC DOOR BOTTOM SEAL AND RUBBER GASKET FOR LIGHT PROOF OR SOUND CONTROL DOORS**

- A. Conform to ANSI A156.22. Provide mortise or under-door type, except where not practical. For mortise automatic door bottoms, provide type specific for door construction (wood or metal).

**2.24 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).

## **2.25 MISCELLANEOUS HARDWARE**

- A. Access Doors (including Sheet Metal, Screen and Woven Wire Mesh Types): Except for fire-rated doors and doors to Temperature Control Cabinets, equip each single or double metal access door with Lock Type E76213, conforming to ANSI A156.5. Key locks as directed. Ship lock prepaid to the door manufacturer. Hinges shall be provided by door manufacturer.
- B. Cylinders for Various Partitions and Doors: Key cylinders same as entrance doors of area in which partitions and door occur, except as otherwise specified. Provide cylinders to operate locking devices where specified for following partitions and doors:
  - 1. Folding doors and partitions.
  - 2. Wicket door (in roll-up door assemblies).
  - 3. Slide-up doors.
  - 4. Swing-up doors.
  - 5. Fire-rated access doors-Engineer's key set.
  - 6. Doors from corridor to electromagnetic shielded room.
  - 7. Day gate on vault door.
- C. 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.

## **2.26 PADLOCKS FOR VARIOUS DOORS, GATES AND HATCHES**

- A. ASTM E883, size 50 mm (2 inch) wide chain; furnish extended shackles as required by job conditions. Provide padlocks, with key cylinders, for each door in following areas as noted.
- B. Key padlocks as follows:
  - 1. Chain Link Fence Gates for Electrical Substation and other Fenced Buildings or Areas: Engineer's set, except as otherwise specified.
  - 2. Roof Access and Scuttles: Engineer's set.

## **2.27 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: 630.
2. Hinges, interior doors: 652 or 630.
3. Pivots: Match door trim.
4. Door Closers: Factory applied paint finish. Dull or Satin Aluminum color.
5. Thresholds: Mill finish aluminum.
6. Cover plates for floor hinges and pivots: 630.
7. 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.

**2.28 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 existing buildings locate hardware on doors at heights to match existing hardware. The Contractor shall visit the site, verify location of existing hardware and submit locations to Resident Engineer for approval.
- B. 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:
- C. 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 except security bedroom, bathroom and anteroom doors which shall have closer installed parallel arm on exterior side of doors. 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:

Door Thickness	Door Width	Hinge Height
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 Resident Engineer. 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
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- 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 Resident Engineer 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 Resident Engineer 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

- A. Following sets of hardware correspond to hardware symbols shown on drawings.

#### HW 1

Each Door to Have:		NON RATED
Butt hinges	Quantity and type as required	
1 Pull plate	J405 (0.050" x 3-1/2" x 15", pull 6" center to center)	
1 Push plate	J301 (0.050" x 3-1/2" x 15")	
1 Closer	C02011/C02021	

HW 2

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Not used

HW 3

<u>Each Door to Have:</u>		<u>NON RATED</u>
Butt hinges	Quantity and type as required	
1 Pull plate	J405 (0.050" x 3-1/2" x 15", pull 6" center to center)	
1 Push plate	J301 (0.050" x 3-1/2" x 15")	
1 Closer	C02011/C02021	
1 Armor plate	J101 x 1.275 mm (0.050 inch) thickness	
1 Overhead holder-stop	C02511	

HW 4

<u>Each Pair to Have:</u>		<u>NON RATED</u>
Butt hinges	Quantity and type as required	
2 Pull plate	J405 (0.050" x 3-1/2" x 15", pull 6" center to center)	
2 Push plate	J301 (0.050" x 3-1/2" x 15")	
2 Closer C02011	C02011/C02021	
4 Armor plate	J101 x 1.275 mm (0.050 inch) thickness	
2 Overhead holder-stop	C02511	

HW 5 - HW 6

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Not used

HW 7

<u>Each Door to Have:</u>		<u>NON RATED</u>
Butt hinges	Quantity and type as required	
1 Push/Pull latch	1562 by Trimco	
1 Gasket seals	R0E154	

HW 8 - HW 11

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Not used

HW 12

<u>Each Door to Have:</u>		<u>NON RATED</u>
Butt hinges	Quantity and type as required	
1 Push-pull plate	J303	
1 Arm pull double base	J400	
1 Closer	C02051	

HW 13

<u>Each Door to Have:</u>		<u>NON RATED</u>
Butt hinges	Quantity and type as required	
1 Lockset (storeroom)	F07	

HW 14

<u>Each Door to Have:</u>		<u>NON RATED</u>
Butt hinges	Quantity and type as required	
1 Latchset (privacy)	F02-MOD; Provide turn piece on both sides of lock	
1 Gasket seals	R0E154	

HW 15 - HW 20

---

Not used

HW 21

<u>Each Pair to Have:</u>		<u>RATED</u>
Butt hinges	Quantity and type as required	
2 Spring hinges	Size as required	
1 Latchset passage)	F01	
1 Closer	C02011/C02021	
1 Coordinator	Type 21A	
1 Gasket seals	R0E154	

HW 22

<u>Each Pair to Have:</u>		<u>RATED</u>
Butt hinges	Quantity and type as required	
2 Spring hinges	Size as required	
1 Lockset (entry)	F04	
1 Closer	C02011/C02021	
1 Coordinator	Type 21A	
1 Gasket seals	R0E154	

HW 23

Each Door to Have: NON RATED

Butt hinges	Quantity and type as required
1 Lockset (entry)	F04

HW 24

---

Not used

HW 25

Each Door to Have: NON RATED

Butt hinges	Quantity and type as required
1 Lockset (classroom)	F05

HW 26 - HW 27

---

Not used

HW 28

Each Pair to Have: NON RATED

Butt hinges	Quantity and type as required
1 Flush bolts	Type 25 - constant latching (top) with automatic flush bolt (bottom)
1 Dust proof strike	L04021
1 Lockset (storeroom)	F07

HW 29 - HW 35

---

Not used

HW 36

Each Pair to Have: NON RATED

1 Pivot set	(Rixson) 127-3/4
1 Emergency door Stop	Stanley ES-1
1 Latchset	F02-MOD; Provide turn piece on both sides of lock.

HW 37

---

Not used

HW 38

Each Pair to Have: NON RATED

---

Butt hinges	Quantity and type as required
1 Latchset (passage)	F01
1 Closer	C02011/C02021
1 Gasket seals	R0E154

HW 39

Each Door to Have: NON RATED

---

Butt hinges	Quantity and type as required
1 Latchset (passage)	F01
1 Closer	C02051/C02061

HW 40

Each Door to Have: NON RATED

---

Butt hinges	Quantity and type as required
1 Lockset (classroom)	F05
1 Closer	C02051/C02061
1 Gasket seals	R0E154

HW 41

Each Door to Have: RATED

---

Butt hinges	Quantity and type as required
1 Latchset (passage)	F01 x 19 mm (3/4 inch) throw
1 Closer	C02011/C02021
1 Gasket seals	R0E154

HW 42

---

Not used

HW 43

Each Door to Have: RATED/NON RATED (as indicated on Drawings)

---

Butt hinges	Quantity and Type as required
1 Lockset (storeroom)	F07
1 Closer	C02011/C02021
1 Gasket seals	R0E154

HW 44

---

Not used

HW 45

Each Door to Have: RATED

---

Butt hinges	Quantity and type as required
1 Lockset (entry)	F04
1 Closer	C02011/C2021
1 Gasket seals	R0E154

HW 46 - HW 51

---

Not used

HW 52

Each Door to Have: NON RATED

---

Butt hinges	Quantity and type as required
1 Lockset (entry)	F04
1 Closer	C02051/C02061
1 Gasket seals	R0E154

HW 53 - HW 83

---

Not used

HW 84

Each Door to Have: NON RATED

---

Butt hinges	Quantity and type as required
1 Panic bolt	Type 1 - Function 08
1 Closer	C02011/C02021

HW 85 - HW 89

---

Not used

HW 90

Each Pair to Have: RATED

---

Butt hinges	Quantity and type as required
1 Panic bolt	Type 8 - Function 01
1 Panic bolt	Type 8 - Function 08
2 Combination closer holders	C00241 (connect to fire alarm system)
1 Gasket seals	R0E154

Note: In lieu of combination closer holder, surface overhead closer with electromagnetic wall holder-release may be used

HW 91

Each Pair to Have: NON RATED

Butt hinges	Quantity and type as required
1 Panic bolt	Type 8 - Function 01
1 Panic bolt	Type 8 - Function 08
2 Closers	C02011/C02021
2 Wall holder-stop	L11301

HW 92 - HW 95

HW 96

Each Opening to Have: NON RATED

1 Sliding door assembly	Hager 9875 Series Complete, for by-pass sliding door; with 9121 Bottom Guide and 9122 Bottom Track)
2 Pulls	J401, 1" round by 12" (Rockwood RM3200)
1 Angle Stop	(Trimco 1217S, apply at back of door as back stop to prevent by-passing door from crushing hand on door pull - provide 1-1/2" clearance from door pull to edge of by-passing door)

HW 97 - HW 110

---

Not used

HW 111

Each Door to Have:

Hardware as required	
Magnetic lock unit	Securitron iMXD-24 (quantity as required)
1 Power Supply	BPS-24-1
1 Key Pad	DK11
1 Push Button	PB-2E

Note: Provide request to exit sensor or request to exit switch kit as required

HW 112 - HW 121

---

Not used

HW 122

Each Opening to Have: NON RATED

Sliding door lock	E16131 (or manual lock by automatic door operator manufacturer)
2 Flush cup pulls	459 (or standard flush pulls by automatic door operator manufacturer)

Note: Automatic sliding door operator and emergency breakout hardware see specification Section 08 71 13

HW 123

Each Opening to Have: NON RATED

Flush cup pull	459 (or standard flush pulls by automatic door operator manufacturer)
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Note: Automatic sliding door operator and emergency breakout hardware see specification Section 08 71 13

HW 124

Each Opening to Have: NON RATED

Flush cup pull	459 (or standard flush pulls by automatic door operator manufacturer)
----------------	---

Note: Automatic sliding door operator and emergency breakout hardware see specification Section 08 71 13

HW 125

Each Opening to Have: NON RATED

Sliding door lock	E16131 (or manual locking by automatic door operator manufacturer)
2 Flush cup pulls	459 (or standard flush pulls by automatic door operator manufacturer)

Notes: Card reader and door position switches, refer to specifications Section 28 13 00

Automatic sliding door operator and emergency breakout hardware see specification Section 08 71 13

HW 126

---

Not used

HW 127

Each Opening to Have: NON RATED

Notes: Card reader and door position switches, refer to specifications Section 28 13 00

Automatic sliding door operator and emergency breakout hardware see specification Section 08 71 13



HW 128

Each Pair to Have: NON RATED

---

Butt hinges	Quantity and type as required
2 Door pulls	J407; Trimco 1802-4
2 Push plates	J304; Trimco 1807-4
2 Armor plates	J101 x 1.275 mm (0.050 inch) thickness

Note: Automatic door operator, see specification Section 08 71 13.

HW 129 - HW 131

---

Not used

HW 132

Each Door to Have: RATED/NON RATED (as indicated on Drawings)

---

Butt hinges	Quantity and type as required
1 Butt hinge (electric through wire)	
1 Electrified Mortise Lock (electrically unlocked/fail secure, request to exit)	
1 Closer	C02011/C02021
1 Gasket seals	R0E154

Notes: Key pad and door position switches, refer to specifications Section 28 13 00

HW 133 - HW 150

---

Not used

HW 151

Each Door to Have: RATED

---

Butt hinges	Quantity and type as required
1 Lockset (classroom)	F05
1 Combination closer holders	C00241
1 Gasket seals	R0E154

HW 152 - HW 168

---

Not used

HW 169

Each Opening to Have: NON RATED

2 Flush cup pulls 459 (or standard flush pulls by automatic door operator manufacturer)

Notes: Card reader, see specifications Section 28 00 00  
Automatic sliding door hardware with fail safe auto lock and emergency breakout hardware, see specifications Section 08 71 13.

HW 170

Each Door to Have: NON RATED

Butt hinges Quantity and type as required  
1 Butt hinge (electric through wire)  
1 Electrified Mortise Lock (electrically unlocked/fail secure, request to exit)  
1 Closer C02011/C02021  
1 Gasket seals R0E154

Note: Card reader and door position switches, refer to specifications Section 28 13 00

HW 171

Each Door to Have: NON RATED

Butt hinges Quantity and type as required  
1 Lockset (storeroom) F07  
1 Closer C02011/C02021  
1 Overhead holder-stop C02511  
1 Gasket seals R0E154

HW 172

Each Pair to Have: NON RATED

Butt hinges Quantity and type as required  
1 Push/Pull latch 1562 By Trimco  
1 Flush bolts Type 25 - constant latching flush bolt (top) with automatic flush bolt (bottom)  
1 Dust proof strike L04021

HW 173

Each Opening to Have: NON RATED

- Sliding door assembly (Hager 9875 Series Complete, for six-panel by-pass sliding doors, three tracks, with 9121 Bottom Guide and 9122 Bottom Track)
- 4 Angle Stops Trimco 1217S; apply at back of doors as back stop to prevent by-passing door from crushing hand on door pull - provide 1-1/2" clearance from door pull to edge of by-passing door
- 6 Pulls J401, 1" round by 12" (Rockwood RM3200)

HW 174

Each Pair to Have: NON RATED

- Butt hinges Quantity and type as required
- 1 Butt hinge (electric through wire)
- 1 Electrified Mortise Lock (electrically unlocked/fail secure, request to exit)
- 2 automatic flush bolts Type 25
- 1 Dust proof strike L04021
- 2 Closers C02011/C02021
- 2 Wall holder-stop L11301
- 1 Coordinator Type 21A

Note: Key pad and door position switches, refer to specifications Section 28  
13 00

HW 175

Each Pair to Have: RATED

- Butt hinges Quantity and type as required
- 2 Panic bolts Type 8 - Function 01 (less bottom rod)
- 1 Fire pin
- 2 Closers C02011/C02021
- 1 Gasket seals R0E154
- 1 Astragal
- 2 Electromagnetic Wall Holders C00011 (connect to fire alarm system)

HW 176

Each Pair to Have: NON RATED

---

Butt hinges	Quantity and type as required
1 Butt hinge (electric through wire)	
1 Electrified Mortise Lock (electrically unlocked/fail secure, request to exit)	
1 Flush bolts	Type 25 - constant latching flush bolt (top) with automatic flush bolt (bottom)
1 Dust proof strike	L04021
2 Overhead holder-stop	C02511
1 Gasket seals	R0E154

Note: Card reader and door position switches, refer to specifications Section 28 13 00

HW 177

Each Pair to Have: NON RATED

---

Butt hinges	Quantity and type as required
2 Panic bolts	Type 7 - Function 08 (less bottom rod)
2 Closers	C02021
1 Double perimeter seals	Pemko S88 and Pemko 29310CS
1 Astragal	Pemko 355CS
1 Drop Bottom Seal	Pemko 434ARL

HW 178

Each Pair to Have: NON RATED

---

Butt hinges	Quantity and type as required
1 Lockset (entry)	F04
1 Flush bolt	Type 25 - constant latching flush bolt
2 Wall holder-stop	L11301

HW 179

Each Pair to Have: NON RATED

---

Butt hinges	Quantity and type as required
1 Panic bolt	Type 7 - Function 01
1 Panic bolt	Type 2 - Function 08
2 Closers	C02011/C02021
2 Overhead/Wall Holders	C02511 or L11301 as appropriate

HW 180

Each Pair to Have: NON RATED

---

Butt hinges	Quantity and type as required
1 Panic bolt	Type 8 - Function 01
1 Panic bolt	Type 3 - Function 09
1 Electric strike	E59391 (fail secure), 24VDC
1 Coordinator	Type 21A

Notes: Card reader and door position switches, refer to specifications Section 28 13 00

Automatic door operator see Specification Section, 08 71 13

HW 181

Each Opening to Have: NON RATED

---

Sliding Door Hardware	(Pemko 280 Series Complete, face mounted with 102N Guide)
1 Flush pull	Type J403; Trimco 1060
1 Door pull	Type J401; 1" round by 12" (Rockwood RM3200, or equal)

HW 182

---

Butt hinges	Quantity and type as required
1 Lockset (entry)	F04
1 Flush bolt	Type 25 - constant latching flush bolt
2 Wall holder-stop	L11301

HW 183

Each Opening to Have: NON RATED

---

Sliding door assembly	(Hager 9875 Series Complete, for three-panel by-pass sliding door; with one track per door leaf; with 9121 Bottom Guide and 9122 Bottom Track)
2 Angle Stops	Trimco 1217S; apply at back of doors as back stop to prevent by-passing door from crushing hand on door pull - provide 1-1/2" clearance from door pull to edge of by-passing door
3 Pulls	J401; 1" round by 12" (Rockwood RM3200)

Note: At doors with mirror faces, provide 1/4 inch stainless steel J-Channel at top and bottom (C.R. Laurence SS960) and double adhesive foam tape.

HW 184

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Not used

HW 185

Each Pair to Have: NON RATED

---

Butt hinges	Quantity and type as required
1 Lockset (storeroom)	F07
1 Flush bolts	Type 25 - constant latching flush bolt (top) with automatic flush bolt (bottom)
1 Dust proof strike	L04021
2 Overhead holder-stop	C02511

HW 186

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Not used

HW 187

Each Door to Have: NON RATED

---

Butt hinges	Quantity and type as required
1 Butt hinge (electric through wire)	
1 Exit device	Delayed egress rim exit device for medium stile aluminum-framed glass door; outside lever trim, always locked, entry by key only, key removable only when locked
1 Closer	C02021

Note: At Door 187, use delayed egress rim exit device, outside lever trim, always locked, entry by key only, key removable only when locked.

HW 188

Each Door to Have: NON RATED

---

Butt hinges	Quantity and type as required
2 Spring hinges	Size as required
1 Latchset (passage)	F01
2 Automatic flush bolts	Type 25
1 Dust proof strike	L04021
1 Closers	C02011/C02021
1 Gasket seals	R0E154
2 Overhead/wall holders	C02511 or L11301 as appropriate
1 Coordinator	Type 21A

HW 189

Each Door to Have: NON RATED

---

Butt hinges	Quantity and type as required
1 Latchset (passage)	F01
1 Closer	C02011/C02021
1 Gasket seals	R0E154

HW 190

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Bottom bar slide bolt for coiling door.

HW 191

<u>Each Door to Have:</u>		<u>NON RATED</u>
1	Butt hinges	Quantity and type as required
1	Lockset	Adams Rite 4900 Heavy Duty Series Deadlatch by 1-1/2 inch backset; 4593 Series Latch Pull, 4591 Deadlatch Paddle; Cylinder as required
1	Closers	C02011/C02021

HW 192

<u>Each Door to Have:</u>		<u>NON RATED</u>
1	Floor Closer	C06011 (with backcheck) by top pivot; for glass patch fitting
2	Pulls	J401; 1-1/4" round by 16" (Rockwood RM3210)
1	Angle stop	Trimco 1217S; for stopless frames

HW 193

<u>Each Door to Have:</u>		<u>NON RATED</u>
	Butt hinges	Quantity and type as required
1	Lockset	Adams Rite 4900 Heavy Duty Series Deadlatch by 1-1/2 inch backset; two 4569 Levers
1	Deadbolt	Adams Rite MS 1850 ANSI - 505; Cylinder as required
1	Closers	C02011/C02021

HW 194

<u>Each Pair to Have:</u>		<u>NON RATED</u>
	Invisible hinges	SOSS; Quantity and type as required
1	Lockset (storeroom)	F07
1	Flush bolt	Type 25 - constant latching flush bolt
2	Angle stops	Trimco 1217S; for stopless frames

HW 195

Each Door to Have: NON RATED

Butt hinges	Quantity and type as required
1 Lockset	Adams Rite 4900 Heavy Duty Series Deadlatch by 1-1/2 inch backset; two 4569 Levers
1 Electric strike	
1 Closers	C02011/C02021

Note: Card reader and door position switches, refer to specifications Section  
28 13 00

HW 196

Each Door to Have: NON RATED

1 Floor Closer	C06011 (with backcheck) by top pivot; for glass patch fitting
2 Pulls	J401; 1-1/4" round by 16" (Rockwood RM3210)
1 Electromagnetic lock	For glass door, 750 lbs holding force.

Note: Key pad and door position switches, refer to specifications Section 28  
13 00

HW 197

Each Door to Have: NON RATED

Butt hinges	Quantity and type as required
1 Lockset (classroom)	F05
1 Wall holder-stop	L11301

HW 198

---

Not used

HW 199

Each Door to Have: NON RATED

Butt hinges	Quantity and type as required
1 Lockset (entry)	F04
1 Perimeter Seals	Pemko S88
1 Drop Bottom Seal	Pemko 434ARL

HW 200

Each Door to Have: NON RATED

Hinges (by chain link fence manufacturer)	
1 Electrified Mortise Lock (electrically unlocked/fail secure)	
1 Power transfer cord	

Note: Card reader and door position switches, refer to specifications Section  
28 13 00



HW 201

Each Door to Have: RATED

---

Butt hinges	Quantity and type as required
1 Lockset (entry)	F04
1 Closer	C02051
1 Perimeter Seals	Pemko S88
1 Drop Bottom Seal	Pemko 434ARL

HW 202

Each Door to Have: NON RATED

---

Butt hinges	Quantity and type as required
1 Butt hinge (electric through wire)	
1 Electrified Mortise Lock (electrically unlocked/fail secure, request to exit)	
1 Closer	C02011/C02021
1 Perimeter Seals	Pemko S88
1 Drop Bottom Seal	Pemko 434ARL

Note: Key pad and door position switches, refer to specifications Section 28  
13 00

HW 203

Each Pair to Have: NON RATED

---

Butt hinges	Quantity and type as required
1 Lockset (classroom)	F05
2 Automatic flush bolts	Type 25
1 Dust proof strike	L04021
2 Closers	C02011/C02021
1 Coordinator	Type 21A
1 Perimeter Seals	Pemko S88
2 Drop Bottom Seal	Pemko 434ARL

HW 204

Each Pair to Have: RATED

---

Butt hinges	Quantity and type as required
1 Lockset (classroom)	F05
2 Automatic flush bolts	Type 25
1 Dust proof strike	L04021
2 Combination closer holders	C00241 (connect to fire alarm system)
1 Coordinator	Type 21A
1 Perimeter Seals	Pemko S88
2 Drop Bottom Seal	Pemko 434ARL

HW 205

Each Door to Have:	RATED/NON RATED (as shown on the Drawings)
Butt hinges	Quantity and type as required
1 Lockset (storeroom)	F07
1 Closer	C02011/C02021
1 Perimeter Seals	Pemko S88
1 Drop Bottom Seal	Pemko 434ARL

HW 206

Each Door to Have:	RATED/NON RATED (as shown on the Drawings)
Butt hinges	Quantity and type as required
1 Lockset (storeroom)	F07
1 Closer	C02011/C02021
1 Double Perimeter Seals	Pemko S88 and Pemko 29310CS
1 Drop Bottom Seal - Pemko 434ARL	

HW 207

Each Door to Have:	RATED
Butt hinges	Quantity and type as required
1 Butt hinge (electric through wire)	
1 Exit Device (Electric)	Type 3 (Mortise), electrically unlocked/fail secure, request to exit.
1 Closer	C02011/C02021
1 Perimeter Seals	Pemko S88
1 Drop Bottom Seal	Pemko 434ARL

Note: Card reader and door position switches, refer to specifications Section 28 13 00

HW 208

Each Pair to Have:	RATED
Hinges	By Sound Control Door Manufacturer
1 Lockset (Storeroom)	F07
1 Closer	C02011/C02021
1 Perimeter Seals	By Sound Control Door Manufacturer
1 Drop Bottom Seal	By Sound Control Door Manufacturer

Note: Provide hardware as required to meet door STC rating indicated on the Door Schedule and in accordance with Section 08 34 73, SOUND CONTROL DOOR ASSEMBLIES.

- - - E N D - - -

**SECTION 08 71 13**

**AUTOMATIC DOOR OPERATORS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies equipment, controls and accessories for automatic operation of sliding doors.

**1.2 RELATED WORK**

- A. Aluminum frames entrance work; Section 08 41 13, ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS.
- B. Door hardware; Section 08 71 00, DOOR HARDWARE.
- C. Section 28 00 00, BASIC SECURITY REQUIREMENTS.
- D. Glass and glazing of doors and frames; Section 08 80 00, GLAZING.
- E. Electric general wiring, connections and equipment requirements; Division 26, ELECTRICAL.
- F. Section 28 31 00, FIRE DETECTION AND ALARM.

**1.3 QUALITY ASSURANCE**

- A. Automatic door operators, controls and other equipment shall be products of a manufacturer regularly engaged in manufacturing such equipment for a minimum of three years.
- B. Source limitations: One type of automatic door equipment shall be used throughout the building.
- C. Equipment installer shall have specialized experience and shall be approved by the manufacturer.

**1.4 WARRANTY**

- A. Automatic door operators shall be subject to the terms of the "Warranty of Construction", FAR clause 52.246-21, except that the Warranty period shall be two years in lieu of one year.

**1.5 MAINTENANCE MANUALS**

- A. In accordance with Section 01 00 00, GENERAL REQUIREMENTS Article titled "INSTRUCTIONS", furnish maintenance manuals and instructions on automatic door operators.

#### 1.6 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's literature and data describing operators, power units, controls, door hardware and safety devices.
- C. Shop Drawings:
  - 1. Showing location of controls and safety devices in relationship to each automatically operated door.
  - 2. Showing layout, profiles, product components, including anchorage, accessories, as applicable.
  - 3. Submit templates, wiring diagrams, fabrication details and other information to coordinate the proper installation of the automatic door operators.
- D. Submit in writing to Resident Engineer that items listed in Article 1.3 are in compliance.

#### 1.7 DESIGN CRITERIA

- A. As a minimum automatic door equipment shall comply with the requirements of BHMA 156.10. Except as otherwise noted on drawings, provide operators which will move the doors from the fully closed to fully opened position in three seconds maximum time interval, when speed adjustment is at maximum setting.
- B. Equipment: Conforming to UL 325. Provide key operated power disconnect wall switch for each door installation.
- C. Electrical Wiring, Connections and Equipment: Provide all motor, starter, controls, associated devices, and interconnecting wiring required for the installation. Equipment and wiring shall be as specified in Division 26, ELECTRICAL.

#### 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. Builders Hardware Manufacturers Association, Inc. (BHMA):
  - 1. A156.10-05 Power Operated Pedestrian Doors (BHMA1601)
- C. National Fire Protection Association (NFPA):
  - 1. 101-05 Life Safety Code
- D. Underwriters Laboratory (UL):
  - 1. 325-02 Door, Drapery, Gate, Louver, and Window Operators and Systems

## **1.9 DELIVERY AND STORAGE**

- A. Delivery shall be in factory's original, unopened, undamaged container with identification labels attached.

## **PART 2 - PRODUCTS**

### **2.1 SLIDING DOOR OPERATORS**

- A. General: Sliding doors shall have electric operators, conforming to BHMA A156.10 and the following requirements as applicable. Assembly shall be single or bi-parting sliding doors as shown on drawings.
- B. Door Operation: Doors shall be opened by electric motor pulling door from closed to open position and shall stop door by electrically reducing voltage and stalling door against mechanical stop. System shall permit manual control of door in event of power failure. Opening and closing speeds shall be adjustable. In compliance with NFPA-101, all door panels shall allow "breakout" to the full open position to provide instant egress at any point in the door's movement.
- C. Operators: Completely assembled and sealed electromechanical operating unit, all located in cast aluminum housing and filled with special lubricant for extreme conditions. Attached to transmission system shall be a minimum 1/8 Hp "DC" shunt-wound permanent magnet motor with sealed ball bearings. Complete unit shall be rubber mounted with provisions for easy maintenance and replacement. Operators shall have adjustable opening and closing cycle. Housing shall be minimum 6063T-5 alloy aluminum not less than .005 mm (125 inch) minimum thickness, 150 mm by 200 mm (6 inch wide by 8 inch high).
- D. Sliding Door Hardware Guide Rollers, Door Carrier: Top door carriers shall ride on steel or delrin rollers incorporating sealed bearings with each door having two support rollers and one anti-rise roller. Each roller shall have a minimum of 9 mm (3/8 inch) of vertical adjustment with positive mechanical locks. Each door shall also include two urethane covered oil impregnated bearing bottom rollers attached with 5 mm (3/16 inch) thick formed steel guide brackets. Each door carrier supporting a door leaf shall include a vertical steel reinforcing member to prevent sagging when door is swung under breakaway conditions. All carbon steel brackets and fittings shall be plated for corrosion resistance.

### **2.2 POWER UNITS**

- A. Each power unit shall be self-contained, electric operated and independent of the door operator. Capacity and size of power circuits shall be in accordance with automatic door operator manufacturer's specifications and Division 26 - ELECTRICAL.

### **2.3 DOOR CONTROLS**

- A. Opening and closing actions of doors shall be actuated by controls and safety devices specified, and conform to ANSI 156.10. Controls shall cause doors to open instantly when control device is actuated; hold doors in open

positions; then, cause doors to close, unless safety device or reactivated control interrupts operation.

B. Manual Controls:

1. Push Plate Wall Switch: Recess type, cast aluminum or stainless steel push plate minimum 100 mm by 100 mm (four inch by four inch), with 13 mm (1/2 inch) high letters "To Operate Door--Push" engraved on face of plate.

- C. Motion Detector: The motion detector may be surface mounted or concealed, to provide a signal to actuate the door operator, and monitor the immediate zone, to detect intrusion by persons, carts or similar objects. The zone which the detector monitors shall be 1500 mm (5 feet) deep and 1500 mm (5 feet) across, plus or minus 150 mm (6 inches) on all dimensions. The maximum response time shall be no less than 25 milliseconds. Unit shall be designed to operate on 24 volts AC. The control shall not be affected by cleaning material, solvents, dust, dirt and outdoor weather conditions.

## 2.4 SAFETY DEVICES

- A. General: Area over which doors slide shall be a safety section and anyone standing in path of door's movement shall be protected by a safety device, except where push controls are shown.
- B. At sliding doors, provide two photoelectric beams mounted at heights of 600 mm (24 inches) and 1200 mm (48 inches) in the door frame on sliding doors. Beams shall parallel door openings to prevent doors from closing when anyone is in the center of the door or doors. When beams are activated, doors shall recycle to full open position. Actuation shall include a motion detector mounted on each side of the door for detection of traffic in each direction.
- C. Time delay switches shall be adjustable between 3 to 60 seconds and shall control closing cycle of doors.
- D. Decals with sign "In" or "Do Not Enter" shall be installed on both faces of each door where shown.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Coordinate installation of equipment with other related work. Manual controls and power disconnect switches shall be recessed or semi-flush mounted in partitions. Secure operator components to adjacent construction with suitable fastenings. Conceal conduits, piping, and electric equipment, in finish work.
- B. Install power units in locations shown. Where units are to be mounted on walls, provide metal supports or shelves for the units. All equipment, including time delay switches, shall be accessible for maintenance and adjustment.

- C. Operators shall be adjusted and must function properly for the type of traffic (pedestrians, carts, stretchers and wheelchairs) expected to pass through doors. Each door leaf of pairs of doors shall open and close in synchronization.
- D. Install controls at positions shown and make them convenient for particular traffic expected to pass through openings. Maximum height of push plate wall switches from finished floors shall be 40 inches unless otherwise approved by the Resident Engineer.

### 3.2 INSTRUCTIONS

- A. Following the installation and final adjustments of the door operators, the installer shall fully Coordinate instruction to VA personnel with Resident Engineer. instruct VA personnel for 2 hours on the operating, servicing and safety requirements for the sliding automatic door operators.
- B. Coordinate instruction to VA personnel with Resident Engineer.

### 3.3 AUTOMATIC DOORS AND OPERATORS SCHEDULE

- A. Door A1100 (from Building Exterior to Lobby, A1-100):
  - 1. Type: Automatic Biparting Sliding Door with Sidelites.
  - 2. Configuration: Fixed-slide/breakout-slide/breakout-fixed.
  - 3. Frame and Glazing:
    - a. Medium-stile frame; provide weatherstripping. Fluorocarbon paint finish.
    - b. Laminated 6 mm (1/4 inch) clear glass, refer to Section 08 80 00, GLAZING.
    - c. Flush-panic device at sliding/breakout doors.
  - 4. Operation:
    - a. Biparting doors actuated with header mounted motion sensor at interior and exterior for detection of traffic in each direction. Door closes after time delay expires. Actuation by header mounted motion sensor at interior and/or exterior may be switched-on and -off - location of switch as indicated on the Drawings.
    - b. Biparting doors actuated by proximity card reader at exterior and by manual actuator push plate at interior - locations as shown on the Drawings. Door closes after time delay expires.
    - c. Connect automatic door operators to emergency electrical system; signal from fire alarm system will switch-on header mounted motion sensor at interior for detection of traffic from inside the building.
- B. Door CA118A (from Building Exterior to Corridor, CA1-19)
  - 1. Type: Automatic Biparting Sliding Door with Sidelites.
  - 2. Configuration: Fixed-slide/breakout-slide/breakout-fixed.
  - 3. Frame and Glazing:
    - a. Medium-stile frame; provide weatherstripping. Fluorocarbon

- paint finish.
- b. Laminated 6 mm (1/4 inch) clear glass, refer to Section 08 80 00, GLAZING.
- c. Flush-panic device at sliding/breakout doors.
- 4. Operation:
  - a. Biparting doors actuated by proximity card reader at exterior and by manual actuator push plate at interior - locations as shown on the Drawings. Door closes after time delay expires.
  - b. Connect automatic door operators to emergency electrical system.
- C. Door CA118B (from Courtyard, A1-CY1 to Corridor, CA1-19); Door A1CY1C (from Courtyard, A1-CY1 to Corridor, CB1-14); Door A1CY1B (from Courtyard, A1-CY1 to Corridor, CB1-14):
  - 1. Type: Automatic Biparting Sliding Door with Sidelites.
  - 2. Configuration: Fixed-slide/breakout-slide/breakout-fixed.
  - 3. Frame and Glazing:
    - a. Medium-stile frame; provide weatherstripping. Fluorocarbon paint finish.
    - b. Laminated 6 mm (1/4 inch) clear glass, refer to Section 08 80 00, GLAZING.
    - c. Flush-panic device at sliding/breakout doors.
  - 4. Operation:
    - a. Biparting doors actuated by proximity card reader at exterior and by manual actuator push plate at interior - locations as shown on the Drawings. Door closes after time delay expires.
    - b. Connect automatic door operators to emergency electrical system.
- D. Door CACA102 (from Elevator Lobby, A1-100D, to Corridor, CA1-01); Door CA118 (from Elevator Lobby, CA1-18A, to Corridor, CA1-06); Door CB221 (from Elevator Lobby, CA2-11A, to Corridor CA2-11):
  - 1. Type: Automatic Biparting Sliding Door with Sidelites.
  - 2. Configuration: Fixed-slide/breakout-slide/breakout-fixed.
  - 3. Frame and Glazing:
    - a. Top and bottom rail; "frameless" stile. Fluorocarbon paint finish.
    - b. Tempered 13 mm (1/2-inch) glazing with etched pattern, refer to Section 08 80 00, GLAZING.
  - 4. Operation:
    - a. Biparting doors actuated with header mounted motion sensor at interior and exterior for detection of traffic in each direction. Door closes after time delay expires. Actuation by header mounted motion sensor at interior and/or exterior may be switched-on and -off at Nurses' Station - location of switch as indicated on the Drawings.
    - b. Biparting doors actuated by manual actuator push plates at locations shown on the Drawings. Door closes after time delay expires.



- c. Biparting doors may be kept at open position by switch at Nurses' Station - location of switch as indicated on the Drawings.
  - d. Connect automatic door operators to emergency electrical system; signal from fire alarm system will actuate biparting doors and keep the doors in the open position.
- E. Door A2100 (from Elevator Lobby, A2-100, to Corridor, CA2-01):
- 1. Type: Automatic Biparting Sliding Door with Sidelites.
  - 2. Configuration: Fixed-slide/breakout-slide/breakout-fixed.
  - 3. Frame and Glazing:
    - a. Top and bottom rail; "frameless" stile. Fluorocarbon paint finish.
    - b. Tempered 13 mm (1/2-inch) glazing with etched pattern, refer to Section 08 80 00, GLAZING.
  - 4. Operation:
    - a. Biparting doors actuated with header mounted motion sensor at interior and exterior for detection of traffic in each direction. Door closes after time delay expires. Actuation by header mounted motion sensor at interior and/or exterior may be switched-on and -off at Nurses' Station - location of switch as indicated on the Drawings.
    - b. Biparting doors actuated by manual actuator push plates at locations shown on the Drawings. Door closes after time delay expires.
    - c. Connect automatic door operators to emergency electrical system.

- - - E N D - - -



**SECTION 09 06 00**

**SCHEDULE FOR FINISHES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section contains a coordinated system in which requirements for materials specified in other sections shown are identified by abbreviated material names and finish codes in the room finish schedule or shown for other locations.

**1.2 MANUFACTURERS**

- A. Manufacturer's trade names and numbers used herein are only to identify colors, finishes, textures and patterns. Products of other manufacturer's equivalent to colors, finishes, textures and patterns of manufacturers listed that meet requirements of technical specifications will be acceptable upon approval in writing by contracting officer for finish requirements.

**1.3 SUBMITTALS**

- A. Submit in accordance with SECTION 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES - provide quadruplicate samples for color approval of materials and finishes specified in this section.

**1.4 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. MASTER PAINTING INSTITUTE: (MPI)
1. 2001 Architectural Painting Specification Manual

**PART 2 - PRODUCTS**

**2.1 DIVISION 05 - METALS**

- A. SECTION 03 30 00, CAST-IN-PLACE CONCRETE

Component	Finish
Floor Slab at Generator Building and Chiller Building	Steel Trowel Finish; Concrete Sealer (see Section 09 91 00)

**2.2 DIVISION 04 - MASONRY**

A. SECTION 04 25 13.13, TERRACOTTA RAINSCREEN PANELS

Finish Code	Finish	Manufacturer	Mfg. Color Name/No.
TC-1	Architectural Terracotta Rainscreen	Shildan, Inc.	Longoton; Colors: Rosé Patinated Texture: Smooth.
TC-2	Architectural Terracotta Rainscreen	Shildan, Inc.	Longoton; Colors: Rosé Patinated Texture: Grooved.

**2.3 DIVISION 05 - METALS**

A. SECTION 05 12 00, STRUCTURAL STEEL FRAMING

Component	Finish	Color
Structural Frame at Generator Building and Chiller Building	Interior High Performance Latex, MPI Gloss level 3 (LL)	Gray

B. SECTION 05 50 00, METAL FABRICATION

Item	Finish
Modular Channel Units	Hot-dip galvanized.
Steel Ladders	Hot-dip galvanized.
Ornamental Railings	Handrail: Stainless Steel No. 7 finish Balusters (Posts): Steel bar, high-build epoxy coating. Glass Infill: 12 mm tempered clear glass, Glass Support: Stainless steel point support fittings: Single Arm Wall/Fin Mounted Fitting: C. R. Laurence Co., Inc.; Cat. No. GRF1BS. Point Support Glass Attachment: C. R. Laurence Co., Inc.; Cat. No. RRF10BS. Stud Fittings: C. R. Laurence Co., Inc.; Cat. No. M10SETBS.
Standard Railings	Handrail: Stainless Steel No. 7 finish Balusters (Posts): Steel bar, high-build epoxy coating. Mesh Infill: Stainless steel wire mesh.
Handrails (Attached to Walls)	Handrail: Stainless Steel No. 4 finish. Product: Construction Specialties; Cat. No. HRS-6C

Item	Finish
Canopy Point-Supported Glass Fittings	Product: Innovative Structural Glass, Inc.; Cat. No. CSF020
Mechanical Screen Wall System	Finish: 3-Coat 70% PVDF Color: PPG Duranar XL, Sunlight Silver
Trellising System	Modular greenscreen by greenscreen; Finish: prime coated with zinc-rich epoxy powder coat; topcoat with polyester-urethane powder coat.

C. SECTION 05 51 00, METAL STAIRS

Component	Finish
Posts	Stainless steel No. 4 finish
Railing	Stainless steel wire mesh infill.
Handrails	Stainless Steel No. 7 finish
Stringers	High-build epoxy coating. Color: P1, see Section 09 91 00
Risers	High-build epoxy coating. Color: P1, see Section 09 91 00
Underside	High-build epoxy coating. Color: P1, see Section 09 91 00

D. SECTION 05 71 00, DECORATIVE METAL STAIRS

Component	Finish
Posts	Steel bar, high-build epoxy coating, Color: P1, see Section 09 91 00
Railing	Glass Infill: 12 mm tempered clear glass, Glass Support: Stainless steel point support fittings
Handrails	Stainless Steel No. 7 finish
Precast Concrete Treads	Color: Dark gray
Stone Veneer	SF1, see Section 09 75 00
Stringers	High-build epoxy coating. Color: P1, see Section 09 91 00
Risers	High-build epoxy coating. Color: P1, see Section 09 91 00

Component	Finish
Underside	High-build epoxy coating. Color: P1, see Section 09 91 00

**2.4 DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES**

A. SECTION 06 20 00, FINISH CARPENTRY

1. FINISH CARPENTRY MATERIALS

Finish Code	Item	Manufacturer	Color Pattern/Name/No.
WP1	Wall Panels	B&N Industries, Inc.	Iconic Panels, Helsinki in FSC-Certified MDF.
WV1	Wood Veneer	-	White Maple; Quarter Sawn
WV2	Wood Veneer	-	Cherry, Quarter Sawn
HPDL-1	Plastic Laminate	Wilsonart	Laminate, Fusion Maple, 7909-60
HPDL-2	Plastic Laminate	Wilsonart	Laminate, Dove Grey, D92-60
HPDL-3	Plastic Laminate	Wilsonart	Laminate, Satin Oxide, 4832-07
SS2	Methyl Methacrylic Polymer Tops	Corian	Aurora, 1/4" thick

**2.5 DIVISION 07 - THERMAL AND MOISTURE PROTECTION**

A. SECTION 07 21 13, THERMAL INSULATION

Item	Finish, Color
Semi-Rigid Acoustic Insulation at Generator Building	Fabric-faced, black color.

B. SECTION 07 40 00, ROOFING AND SIDING PANELS

Item	Manufacturer	Finish/Mfg. Color Name/No.
Corrugated Metal Panels	Centria	3-Coat 70% PVDF; Concept Series - Concealed Fasteners: CS-660E; Color: Duranar Sunstorm Sunlight Silver
Mechanical Screen Wall Panels	Centria	3-Coat 70% PVDF; EcoScreen Perforated Screenwall CS-660; Color: Duranar Sunstorm Sunlight Silver
Roof Panels	AEP Span (ASC Profiles, Inc.)	3-Coat 70% PVDF; Snap-Seam; Color: Duranar Sunstorm Sunlight Silver

C. SECTION 07 42 19, METAL PLATE WALL PANELS

Item	Manufacturer	Finish/Mfg. Color Name/No.
Metal Plate Wall Panels	Firestone Metal Products	3-Coat 70% PVDF; Una-Clip 4500 Series; Color: Duranar Sunstorm Sunlight Silver

D. SECTION 07 52 16, STYRENE-BUTADIENE-STYRENE MODIFIED BITUMINOUS MEMBRANE ROOFING

Color	Manufacturer
White	Johns Manville

E. SECTION 07 55 63, VEGETATED PROTECTED MEMBRANE ROOFING

Manufacturer	Mfg. Color Name/No.
American Hydrotech, Inc.	Extensive Garden Roof

F. SECTION 07 60 00, FLASHING AND SHEET METAL

Item	Material	Finish
Copings	Aluminum	3-coat 70% PVDF Finish
Reglet and Counter Flashing	Galvanized Steel	3-coat 70% PVDF Finish

G. SECTION 07 92 00, JOINT SEALANTS

Location	Color
Precast Concrete Panels	Color to match precast concrete panels.

2.6 DIVISION 08 - OPENINGS

A. SECTION 08 11 13, HOLLOW METAL DOORS AND FRAMES

Component	Color of Paint Type and Gloss
Door and Frame (Generator Building and Chiller Building)	Interior High Performance Latex, MPI Gloss level 3 (LL) Color: Gray
Exterior Door and Frame (Polytrauma and Blind Rehabilitation Building)	Exterior face, field-applied PVDF, color to match glazed aluminum curtain wall
Interior Door	see Section 09 91 00, PAINTS; Paint Code P2
Frame	see Section 09 91 00, PAINTS; Paint Code P2
Window frame	see Section 09 91 00, PAINTS; Paint Code P2
Note: Paint both sides of door and frames same color including ferrous metal louvers, and hardware attached to door	

B. SECTION 08 14 00, INTERIOR WOOD DOORS

Component	Finish/Color
Doors	Eggers Industries; Wood Veneer: Refer to 06 20 00, FINISH CARPENTRY; wood veneer types WV1 and WV2.
Frames	(see Section 08 11 13, HOLLOW METAL DOORS AND FRAMES)

C. SECTION 08 44 13, SOUND CONTROL DOOR ASSEMBLIES

Component	Finish/Color
Doors	(see Section 08 14 00, INTERIOR WOOD DOORS)
Frames	(see Section 08 11 13, HOLLOW METAL DOORS AND FRAMES)

D. SECTION 08 31 13, ACCESS DOORS AND FRAMES

Material	Finish/Color
Steel	Color to match adjacent wall finish
Stainless steel	No. 4 stainless steel finish



E. SECTION 08 33 00, COILING DOORS

Item	Material	Finish
Door	Steel	P1, see Section 09 91 00, PAINT AND COATINGS

F. SECTION 08 33 13.13, COILING WOOD COUNTER DOORS

Component	Manufacturer, Finish
Coiling Wood Counter Doors	Woodfold; Maple

G. SECTION 08 41 13, ALUMINUM FRAMED ENTRANCES

Component	Manufacturer Color Name/No.
Aluminum Framed Glass Doors	Color: Duranar Sunstorm Sunlight Silver

H. SECTION 08 44 13, GLAZED ALUMINUM CURTAIN WALLS

Curtain Wall Type	Manufacturer	Mfg. Color Name/No.
WW-1 and CW-1	Wausau Window and Wall Systems	6750 SG Series, blast-hazard mitigation compliant Finish: 3-Coat 70% PVDF Color: PPG Duranar Sunstorm Sunlight Silver. Shadow Box Color: Match color of mullions.
WW-2	Wausau Window and Wall Systems	Superwall Series, blast-hazard mitigation compliant Finish: 3-Coat 70% PVDF Color: PPG Duranar Sunstorm Sunlight Silver.

I. SECTION 08 44 26.23 - SPECIALTY GLAZED-STRUCTURAL ASSEMBLIES

Curtain Wall Type	Manufacturer	Mfg. Color Name/No.
CW-2	Novum Structures of Menomonee Falls, WI	Glazed Cable Net System Stainless Steel: Satin finish. Glazing: Insulated Glazing units, refer to Section 08 80 00. GLAZING

J. SECTION 08 51 13.11, SIDE-HINGED ALUMINUM WINDOWS

Type	Manufacturer	Glazing	Mfg. Color Name/No.
Side-Hinged (inswinging) Windows, Blast-hazard mitigation compliant	Wausau Window and Wall Systems	Insulated Glazing Units, refer to Section 08 80 00. GLAZING	4250i-XLT BHM project-in casement Aluminum Finish: 3-Coat 70% PVDF; Color: PPG Duranar Sunstorm Sunlight Silver.

K. SECTION 08 80 00, GLAZING

Glazing Type	Manufacturer	Mfg. Color Name/No.
G-1	Viracon	Low-E Sealed-Edge Insulating Glass Unit - Clear, blast mitigation (50' standoff distance) Outer Lite: 6 mm (1/4") Heat-Strengthened (HS) Glass Air Gap: 13 mm (1/2") Inner Lite: 4.75 mm (3/16") Annealed Glass + 1.5 mm (0.060") PVB + 4.75 mm (3/16") Annealed Glass Low-E Coating on No. 2 surface (VNE-63)
G-1T	Viracon	Low-E Sealed-Edge Insulating Glass Unit - Clear Tempered, blast mitigation (50' standoff distance) Outer Lite: 6 mm (1/4") Fully Tempered (FT) Glass Air Gap: 13 mm (1/2") Inner Lite: 4.75 mm (3/16") Annealed Glass + 1.5 mm (0.060") PVB + 4.75 mm (3/16") Annealed Glass Low-E Coating on No. 2 surface (VNE-63)
G-2	Viracon	Low-E Sealed-Edge Insulating Glass Unit - Simulated Acid Etch, blast mitigation (50' standoff distance) Outer Lite: 6 mm (1/4") Heat-Strengthened (HS) Glass Air Gap: 13 mm (1/2") Inner Lite: 4.75 mm (3/16") Annealed Glass + 1.5 mm (0.060") PVB + 4.75 mm (3/16") Annealed Glass Low-E Coating on No. 2 surface (VNE-63) Simulated Acid Etch Ceramic Frit on No. 6 surface (V1085)
G-2T	Viracon	Low-E Sealed-Edge Insulating Glass Unit - Simulated Acid Etch, Tempered, blast mitigation (50' standoff distance) Outer Lite: 6 mm (1/4") Fully Tempered (FT) Glass Air Gap: 13 mm (1/2") Inner Lite: 4.75 mm (3/16") Annealed Glass + 1.5 mm (0.060") PVB + 4.75 mm (3/16") Annealed Glass Low-E Coating on No. 2 surface (VNE-63) Simulated Acid Etch Ceramic Frit on No. 6 surface (V1085)

Glazing Type	Manufacturer	Mfg. Color Name/No.
G-3	Viracon	Laminated Glass - Clear; 6 mm (1/4") Two layers of 3 mm (1/8") Annealed Glass with (0.060") PVB interlayer.
G-4	Viracon	Laminated Glass - Simulated Acid Etch Two layers of 3 mm (1/8") Annealed Glass with (0.060") PVB interlayer. Simulated Acid Etch Ceramic Frit on No. 4 surface (V1085)
G-5	Viracon	Laminated Glass - Clear; 25 mm (1"), Silk-Screened Two layers of 13 mm (1/2") Annealed Glass with (0.060") PVB interlayer. Low-E Coating on No. 2 surface (VE-85); Simulated Acid Etch Ceramic Frit on No. 3 surface (V1085)
IG-1	-	Monolithic Glass - Clear; 6 mm (1/4")
IG-2	-	Monolithic Glass - Clear, Fully Tempered; 6 mm (1/4")
IG-3	SaftiFirst	Fire-Resistance Rated Glazing, SuperLite II-XL 120; 38 mm (1-1/2")
IG-4	Skyline Design	Patterned Monolithic Glass, Fully Tempered; 6 mm (1/4"), Pattern: Cascade
IG-5		Monolithic Glass - Clear, Fully Tempered; 13 mm (1/2")
IG-6	Skyline Design	Patterned Monolithic Glass, Fully Tempered; 13 mm (1/2"), Pattern: Cascade
IG-7	Skyline Design	Patterned Monolithic Glass; 10 mm (3/8"), Pattern: Cascade
IG-8	Skyline Design	Patterned Monolithic Glass, Fully Tempered; 10 mm (3/8"), Pattern: Cascade
IG-9		Monolithic Glass - Clear; 10 mm (3/8")

L. SECTION 08 90 00, LOUVERS

Item	Material	Finish	Mfg. Color Name/No.
Fixed Louver	Aluminum	2-coat 70% PVDF	Airolite, Model No. K6776; Color: Dove Gray
Removable Louver	Aluminum	2-coat 70% PVDF	Airolite, Model No. K6776; Color: Dove Gray

**2.7 DIVISION 09 - FINISHES**

A. SECTION 09 30 13, CERAMIC/PORCELAIN TILING

1. CERAMIC TILING

Finish Code	Manufacturer	Mfg. Color Name/No
PT1	Porcelanosa USA	Porcelain Floor/Wall Tile; Tile Name: Silk Verde; Size: 17" x 26" x 3/8" Joint Width: 1/16" Grout: Custom Building Products; Saltillo Grout Color; #9, Natural Gray
PT2	Caesar Ceramics USA	Porcelain Floor/Wall Tile; Tile Name: Feel Colonial Size: 23-5/8" x 23-5/8" x 3/8" Joint Width: 1/16" Grout: Custom Building Products; Saltillo Grout Color; #382, Bone
PT3	Caesar Ceramics USA	Porcelain Wall Tile; Tile Name: Feel Zanzibar Size: 23-5/8" x 23-5/8" x 3/8" Joint Width: 1/16" Grout: Custom Building Products; Saltillo Grout Color; #95, Sable Brown
PT4	Not used	
PT5	Porcelanosa USA	Ceramic Wall Tile; Tile Name: Yakarta; Size: 12" x 35" x 1/2" Joint Width: 1/16" Grout: Custom Building Products; Saltillo Grout Color; #380, Haystack
PT6	Not used	
PT7	Porcelanosa USA	Porcelain Floor/Wall Tile; Tile Name: Area Nature; Size: 12" x 12" Joint Width: 1/16" Trims: Cove Base, Outside Corner (note: miter inside corners) Grout: Custom Building Products; Saltillo Grout Color; #380, Haystack

Finish Code	Manufacturer	Mfg. Color Name/No
PT8	Porcelanosa USA	Porcelain Floor/Wall Tile; Tile Name: Slate Amazonas; Size: 4" x 4" x 5/16" Joint Width: 1/16" Grout: Custom Building Products; Saltillo Grout Color; #380, Haystack
PT9	Porcelanosa USA	Porcelain Floor/Wall Tile; Tile Name: Slate River; Size: 4" x 4" x 5/16" Joint Width: 1/16" Grout: Custom Building Products; Saltillo Grout Color; #380, Haystack
PT10	Caesar Ceramics USA	Porcelain Floor/Wall Tile; Tile Name: Quartzite di Barge Size: 12" x 24" wall modules Joint Width: 1/16" Grout: Custom Building Products; Saltillo Grout Color; #380, Haystack
PT11	Not used	
PT12	Not used	
CT1	Porcelanosa USA	Ceramic Tile; Tile Name: Line Crema; Size: 8" x 13" x 5/16" Joint Width: 1/16" Grout: Custom Building Products; Saltillo Grout Color; #382, Bone
CT2	Porcelanosa USA	Ceramic Wall Tile; Tile Name: Line Blanco; Size: 8" x 13" x 5/16" Grout: Custom Building Products; Saltillo Grout Color; #382, Bone
CT3	Porcelanosa USA	Ceramic Wall Tile; Tile Name: Dados Crema; Size: 8" x 13" x 5/16" Joint Width: 1/16" Grout: Custom Building Products; Saltillo Grout Color; #382, Bone

Finish Code	Manufacturer	Mfg. Color Name/No
CT4	Daltile	Ceramic Floor/Base Tile; Tile Name: Keystones D161 Urban Putty (walls - glazed, floors - unglazed); Size: 3" x 3" Trim Units: 2" x 1" Cove #3833 Joint Width: 1/16"  Ceramic Wall Tile; Tile Name: Permbrates, 6461 Urban Putty (gloss); Size 3" x 3" Joint Width: 1/16"  Grout: Custom Building Products; Saltillo Grout Color; #380, Haystack

2. METAL DIVIDER STRIPS

Size	Material	Manufacturer
12.5 mm x 22.5 mm	Metal Divider Strips: Stainless Steel	Butech/Porcelanosa, pro-mate 2, B71142003

B. SECTION 09 51 00, ACOUSTICAL CEILINGS

Finish Code	Component	Manufacturer	Size/Color/Pattern	Mfg Series, Item No./ Grid System
AT	Acoustical Panel Ceiling, Type IV	Armstrong	24" x 24" x 3/4"; White; Form 2, Pattern E	Ultima 9/16" Beveled Tegular #1912; Interlude XL 9/16" Dimensional Tee System with shadow molding
AT(SP)	Acoustical Panel Ceiling, Type IV	Armstrong	24" x 24" x 5/8"; White; Form 2, Pattern E	Clean Room VL Unperforated #868; Prelude XL Fire Guard 15/16" Exposed Tee System
AT1	Acoustical panel, monolithic, large format	Hunter Douglas	Sizes as shown on Drawings; White	TechStyle-E Classic (Clipped); standard 15/16" Tee grid

Finish Code	Component	Manufacturer	Size/Color/Pattern	Mfg Series, Item No./ Grid System
AT2	Acoustical Semi-Rigid Boards (see Section 07 21 13, THERMAL INSULATION)	Johns Manville	Black	Permacote Linacoustic R-300, Rigid Fiber Glass Plenum Liner Board

C. SECTION 09 54 26, LINEAR WOOD CEILINGS

Finish Code	Component	Manufacturer	Mfg Name/No.
WL1	Linear Wood Ceilings	9wood, Inc.	Style 2100 - Panelized Linear; Wood veneer WV1, refer to SECTION 06 20 00, FINISH CARPENTRY, with flexible backer
WL2	Linear Wood Ceilings	9wood, Inc.	Style 2100 - Panelized Linear; Wood veneer WV2, refer to SECTION 06 20 00, FINISH CARPENTRY

D. SECTION 09 64 00, WOOD FLOORING

Finish Code	Manufacturer	Color Pattern/ Name/No.
WD1	Armstrong Commercial Hardwood	Engineered Hardwood; Size: 5/8" x 3-1/2" x random lengths; Valenza Collection, Tigerwood, Natural

E. SECTION 09 65 13, RESILIENT BASE AND ACCESSORIES

Finish Code	Height	Manufacturer	Mfg Name/No.
RB1	6-1/4"	Johnsonite	Tightlock Wallbase for Resilient; Color: 179 Steel
RB2	6"	Johnsonite	Tightlock Wallbase for Carpet; Color: 179 Steel
RB3	4"	Johnsonite	Tightlock Wallbase for Resilient; Color: 179 Steel
RB4	4"	Johnsonite	Tightlock Wallbase for Carpet; Color: 179 Steel
RB5	4"	Johnsonite	Tightlock Wallbase for Resilient; Color: 59 Heather Green

F. SECTION 09 65 16, RESILIENT SHEET FLOORING

1. VINYL SHEET FLOORING (VSF)

Finish Code	Manufacturer	Pattern name	Mfg. Color Name/No.
RSF1	Lonseal	Loneco	#215 Sea Coast

G. SECTION 09 65 19, RESILIENT TILE FLOORING

Finish Code	Size	Material/Component	Manufacturer	Mfg Name/No.
LVT1	18" x 18" x 0.125"	RT	Armstrong	Natural Creations, Mystix; Color: Aria Natural, TP780
LVT2	18" x 18" x 0.125"	RT	Armstrong	Natural Creations, Mystix; Color: Jet Natural, TP782
LVT3	18" x 18" x 0.125"	RT	Armstrong	Natural Creations, Mystix; Color: Stream Natural, TP781
LVT4	18" x 18" x 0.125"	RT	Armstrong	Natural Creations, Mystix; Color: Aria Bronze, TP784
LVT5	18" x 18" x 0.125"	RT	Armstrong	Natural Creations, Mystix; Color: Jet Bronze, TP786
LVT6	18" x 18" x 0.125"	RT	Armstrong	Natural Creations, Mystix; Color: Aria Gray Beige, TP776
LVT10	4.5" x 36" x 0.0984"	RT	Centiva	Color: American Cherry, #WP3305-E, Natural Grain, Standard Edge
VCT1	12" x 12" x 1/8"	RT	Armstrong	Excelon Stonetex; Color: Forest Moss, #52155
RF1	-	RF	ECORE Int'l, ECOsurfaces Commercial Flooring	ECOstone; Rollin' Stone #810
RF2	-	RF	ECORE Int'l, ECOsurfaces Commercial Flooring	ECOstone; Rock N' Coal #814
RF3	24" x 24" x 0.125"	RF	Johnsonite	Roundel Solid Color Rubber Tile; Color: Heather Green, #59, Weathered Finish (WRT)



H. SECTION 09 65 36, STATIC-CONTROL RESILIENT TILE FLOORING

Finish Code	Size	Manufacturer	Mfg Name/No.
SDT1	12" x 12" x 1/8"	Armstrong	SDT; Color: Marble Beige, #51950

I. SECTION 09 67 23, RESINOUS FLOORING

Finish Code	Manufacturer	Mfg. Color Name/No.
RES1	Stonhard, Inc.	Flooring: Stonres RTZ; Color: Canvas Cove Base: Stonclad GR with Stonkote GS4; Color: Match flooring color.

J. SECTION 09 67 23.50, RESINOUS (EPOXY TERRAZZO) FLOORING

Finish Code	Manufacturer	Mfg. Color Name/No.
RT	-	As selected by VA Resident Engineer from manufacturer's standard colors.

K. SECTION 09 68 00, CARPETING

1. CARPET (CPT)

Finish Code	Manufacturer	Mfg. Color Name/No.
CPT1	InterfaceFLOR, LLC	Reinvent Color: Macrame, #8983 Install Pattern: Brick layout
CPT2	InterfaceFLOR, LLC	Reinvent Color: Citron, #8979 Install Pattern: Brick layout

2. CARPET TRANSITION STRIP

Material	Manufacturer	Mfg. Color Name/No.
Vinyl	Johnsonite	#29 Moonrock WG

L. SECTION 09 72 21, FABRIC WALL COVERINGS (W)

Finish Code	Manufacturer	Mfg. Color Name/No.
WF1	Carnegie/Xorel	6741 W141

M. SECTION 09 75 00, STONE FACING

Finish Code	Material	Manufacturer	Color
SF1	Stone Veneer	ASN Natural Stone, Inc.	Lido Venezian #041A

N. SECTION 09 84 33, SOUND-ABSORBING WALL UNITS

1. ACOUSTICAL WALL PANELING (AWP)

Finish Code	Manufacturer	Mfg. Color Name/No.
AWF1	Carnegie/Xorel	Strie; Color: 6423 F106
AWF2	Carnegie/Xorel	Strie; Color: 6423 F137
AWF3	Carnegie/Xorel	Strie; Color: 6423 F116
AWF4	Carnegie/Xorel	Strie; Color: 6423 F127
AWF5	Carnegie/Xorel	Strie; Color: 6423 F134
AWF6	Carnegie/Xorel	Strie; Color: 6423 F129
AWF7	Carnegie/Xorel	Strie; Color: 6423 F131
AWF8	Carnegie/Xorel	Strie; Color: 6423 F136
AWF9	Carnegie/Xorel	Strie; Color: 6423 F124
AWF10	Carnegie/Xorel	Lily Embroider; Color: 6723 F106
AWF11	Carnegie/Xorel	Strie; Color: 6423 F138
AWF12	Carnegie/Xorel	Sway Embroider; Color: 6729 F134
AWF13	Acoustical Solutions Inc.	Acoustone Speaker Grill, Cloth #FR7012
AW1	Wall Technology, CDC Corporation	Foundations Acoustical Wall Panels; 1-1/16"; Color: White Scrim

O. SECTION 09 91 00, PAINT AND COATINGS

1. MPI Gloss and Sheen Standards

		Gloss @60	Sheen @85
Gloss Level 1	A traditional matte finish-flat	Max. 5 units, and	Max 10 units
Gloss Level 2	A high side sheen flat - "a velvet-like" finish	Max 10 units, and	10-35 units
Gloss Level 3	A traditional "egg-shell like" finish	10-25 units, and	10-35 units
Gloss Level 4	A "satin-like" finish	20-35 units, and	Min. 35 units

			Gloss @60	Sheen @85
Gloss Level 5	A traditional semi-gloss	35-70 units		
Gloss Level 6	A traditional gloss	70-85 units		
Gloss Level 7	A high gloss	More than 85 units		

2. PAINTS (OPAQUE)

Paint Code	Gloss	Manufacturer	Mfg. Color Name/No.
P1	Level 3 or 5	Kelly Moore	Taravel, OW236-1
P2	Level 3 or 5	Kelly Moore	Granite Cliff, KM3933-2
P3	Level 3	Kelly Moore	Balsam Brown, KM3997-2
P4	Level 1	Kelly Moore	Pristine Linen, OW228-1
P5	Level 3	Kelly Moore	Cubicle Blues, KM3805-2
P6	Level 3	Kelly Moore	Portsmouth Olive, KM3405-2
P7	Level 3	Kelly Moore	Autumn Beauty, KM3575-3
P8	Level 3	Kelly Moore	Honey Mustard, KM3485-2
P9	Level 3	Sherwin Williams	Halcyon Green, #6213
P10	Level 5	Kelly Moore	High-build epoxy to match Kelly Moore Taravel, OW236-1

Note:  
 Unless otherwise noted, use paint color P4 on all painted ceiling surfaces.

P. SECTION 10 26 00, WALL AND DOOR PROTECTION

Item/ Finish Code	Material	Manufacturer	Mfg. Color Name/No.
Corner Guards CG1	PVC-Free	Construction Specialties	Acrovyn 3000; Color: Pearl, #934
Corner Guards CG2	PVC-Free	Construction Specialties	Acrovyn 3000; Color: Chinchilla, #194
Corner Guards CG3	PVC-Free	Construction Specialties	Acrovyn 3000; Color: Toffee, #480
Wall Guard WG1	PVC-Free	Construction Specialties	Acrovyn 3000; 0.060" Sheet Color: Pearl, #934
Wall Guard WG2	PVC-Free	Construction Specialties	Acrovyn 3000; 0.060" Sheet Color: Chinchilla, #194

Item/ Finish Code	Material	Manufacturer	Mfg. Color Name/No.
Wall Guard WG3	PVC-Free	Construction Specialties	Acrovyn 3000; 0.060" Sheet Color: Toffee, #480
Wall Guard WG4	3/4" MDF with Wood Veneer	-	WV2 Wood Veneer, refer to Section 06 20 00, FINISH CARPENTRY
Wall Guard (Crash Rail) WG5	PVC-Free	Construction Specialties	Acrovyn 3000; Color: Pearl, #934
Handrail/Wall Guard Combination	Wood	Construction Specialties	Model No. AW-10C Wood species: Maple to match WV1 per Section 06 20 00, FINISH CARPENTRY
Door Protection (Kick Plate) K2	PVC-Free	Construction Specialties	Acrovyn 3000; 0.060" Sheet Color: Chinchilla, #194
Door Protection (Kick Plate) K4	PVC	Construction Specialties	Acrovyn 3000; 0.060" Sheet Color: Maple
Door Protection (Kick Plate) K6	Stainless Steel		Brushed, No. 4 Stainless Steel Finish

Q. SECTION 10 51 13, METAL LOCKERS

Item/ Type	Finish	Manufacturer	Mfg. Color Name/No.
L-1	Baked Enamel	Penco	Vanguard #6331V; 073 Champagne

2.8 DIVISION 12- FURNISHINGS

A. SECTION 12 24 00, WINDOW SHADES

Component	Material	Manufacturer	Mfg. Color Name/No.
Shade Cloth	Thermoplastic Olefin (TPO) fiber filaments with a TPO coating	MechoShade	Openness factor: 3%; Color: 1370 Shadow Grey

B. SECTION 12 24 21, LIGHTPROOF SHADES

Component	Material	Manufacturer	Mfg. Color Name/No.
Shade Cloth	Woven fiberglass with acrylics backing and aqueous anti-static coating	MechoShade	Openness factor: 0%; Color: 0106 Dusk

C. SECTION 12 32 00, MANUFACTURED CASEWORK

Component	Material	Manufacturer	Mfg. Color Name/No.
WV2	Wood Veneer	-	Cherry, Quarter Sawn
HPDL-1	Plastic Laminate	Wilsonart	Laminate, Fusion Maple, 7909-60
HPDL-2	Plastic Laminate	Wilsonart	Laminate, Dove Grey, D92-60
HPDL-3	Plastic Laminate	Wilsonart	Laminate, Satin Oxide, 4832-07

Notes:

- Refer to Section 12 36 00, for solid surfacing and quartz counter tops.
- Refer to Drawings Sheet AE8.5.1, Schedule Legend for HDPL and Wood Veneer applications.
- Refer to elevations and casework legend symbols for casework finishes. Where fifth digit in casework legend symbol is omitted, all cabinets (base, wall, and full cabinet) shall have the same finish as that where the fifth digit in casework legend symbol is indicated.

D. SECTION 12 36 00, COUNTERTOPS

Finish Code	Material	Manufacturer	Mfg. Color Name/No.
SS1	Methyl Methacrylic Polymer Tops	Corian	Rafia
QT1	Natural Quartz	Dupont Zodiac	Crema Marfil
QT2	Natural Quartz	CaesarStone	#3380

E. SECTION 12 48 16, ENTRANCE FLOOR GRILLES

Component	Mfg. Color Name/No
Aluminum Gratings and Frames	Mats Inc., Mill finish; SafeTrack Aluminum Foot Grilles

**2.9 DIVISION 14 - CONVEYING SYSTEMS**

A. SECTION 14 24 00, HYDRAULIC ELEVATORS

1. Passenger Elevators Nos. P1 and P2			
Component	Material	Finish	Color
Hoistway Entrances	14 ga. Stainless Steel	No. 4 Stainless Steel	-
Hoistway Doors	16 ga. Stainless Steel	No. 4 Stainless Steel	-
Corridor Position Indicator	3 mm thick flat Stainless Steel	No. 4 Stainless Steel	-
Car Canopy	Linear Wood Ceiling	WL1, see Section 09 54 26	-
Car interior finishes (refer to drawings for interior finishes pattern and layout)	Bonded metal composite	Forms + Surfaces; Bonded Metal; Bonded Gold Bronze; "Mara" pattern; minimum 4.8 mm thick.	Natural patina
	Stainless Steel	Forms + Surfaces; Sandstone Finish; minimum 0.8 mm thick.	-
Car Floor	Luxury Vinyl tile	LVT6, see Section 09 65 19	-
Corridor Call Buttons	3 mm thick flat Stainless Steel	No. 4 Stainless Steel	-
Car Doors	16 ga. Stainless Steel	No. 4 Stainless Steel	-
Car Door Frame	14 ga. Stainless Steel	No. 4 Stainless Steel	-
Corridor Position Indicator	3 mm thick flat Stainless Steel	No. 4 Stainless Steel	-
Car Operating Panel	3 mm thick flat Stainless Steel	No. 4 Stainless Steel	-

2. Service Elevators Nos. S1 and S2			
Component	Material	Finish	Color
Hoistway Entrances	16 ga. Stainless Steel	No. 4 Stainless Steel	-
Hoistway Doors	16 ga. Stainless Steel	No. 4 Stainless Steel	-

2. Service Elevators Nos. S1 and S2			
Component	Material	Finish	Color
Corridor Position Indicator	3 mm thick flat Stainless Steel	No. 4 Stainless Steel	-
Car Canopy	16 ga. Stainless Steel	No. 4 Stainless Steel	-
Car Wainscot	14 ga. Stainless Steel	No. 4 Stainless Steel	-
Panels Above Wainscot	14 ga. Stainless Steel	No. 4 Stainless Steel	-
Car Floor	Luxury Vinyl tile	LVT6, see Section 09 65 19	-
Corridor Call Buttons	3 mm thick flat Stainless Steel	No. 4 Stainless Steel	-
Car Doors	16 ga. Stainless Steel	No. 4 Stainless Steel	-
Car Door Frame	14 ga. Stainless Steel	No. 4 Stainless Steel	-
Corridor Position Indicator	3 mm thick flat Stainless Steel	No. 4 Stainless Steel	-
Car Operating Panel	3 mm thick flat Stainless Steel	No. 4 Stainless Steel	-

**PART 3 - EXECUTION**

**3.1 FINISH SCHEDULES & MISCELLANEOUS ABBREVIATIONS**

Term	Abbreviation
Access Flooring	AF
Accordion Folding Partition	AFP
Acoustical Ceiling	AT
Acoustical Ceiling, Special Faced	AT (SP)
Acoustical Metal Pan Ceiling	AMP
Acoustical Wall Panel	AWP
Acoustical Wall Treatment	AWT

Term	Abbreviation
Acoustical Wallcovering	AWF
Anodized Aluminum Colored	AAC
Anodized Aluminum Natural Finish	AA
Baked On Enamel	BE
Brick Face	BR
Brick Flooring	BF
Brick Paving	BP
Carpet	CP
Carpet Athletic Flooring	CAF

Term	Abbreviation
Carpet Module Tile	CPT
Ceramic Glazed Facing Brick	CGFB
Ceramic Mosaic Tile	FTCT
Concrete	C
Concrete Masonry Unit	CMU
Divider Strips Marble	DS MB
Epoxy Coating	EC
Epoxy Resin Flooring	ERF
Existing	E
Exposed Divider Strips	EXP
Exterior	EXT
Exterior Finish System	EFS
Exterior Paint	EXT-P
Exterior Stain	EXT-ST
Fabric Wallcovering	WF
Facing Tile	SCT
Feature Strips	FS
Floor Mats & Frames	FM
Floor Tile, Mosaic	FT
Fluorocarbon	FC
Folding Panel Partition	FP
Foot Grille	FG
Glass Masonry Unit	GUMU
Glazed Face CMU	GCMU

Term	Abbreviation
Glazed Structural Facing Tile	SFTU
Granite	GT
Gypsum Wallboard	GWB
High Glazed Coating	SC
Latex Mastic Flooring	LM
Linear Metal Ceiling	LMC
Linear Wood Ceiling	LWC
Marble	MB
Material	MAT
Mortar	M
Multi-Color Coating	MC
Natural Finish	NF
Paint	P
Paver Tile	PVT
Perforated Metal Facing (Tile or Panels)	PMF
Plaster	PL
Plaster High Strength	HSPL
Plaster Keene Cement	KC
Plastic Laminate	HPDL
Polypropylene Fabric Wallcovering	PFW
Porcelain Paver Tile	PPT
Quarry Tile	QT
Radiant Ceiling Panel System	RCP
Resilient Stair Tread	RST



Term	Abbreviation
Rubber Base	RB
Rubber Tile Flooring	RT
Spandrel Glass	SLG
Stain	ST
Stone Flooring	SF
Structural Clay	SC
Suspension Decorative Grids Grids	SDG
Terrazzo Portland Cement	PCT
Terrazzo Tile	TT
Terrazzo, Thin Set	
Textured Gypsum Ceiling Panel	TGC

Term	Abbreviation
Textured Metal Ceiling Panel	TMC
Thin set Terrazzo	TST
Veneer Plaster	VP
Vinyl Base	VB
Vinyl Coated Fabric Wallcovering	W
Vinyl Composition Tile	VCT
Vinyl Sheet Flooring	VSF
Vinyl Sheet Flooring (Welded Seams)	WSF
Wall Border	WB
Wood	WD

### 3.2 ROOM FINISH SCHEDULE

A. ROOM FINISH SCHEDULE: Refer to Drawing Sheets AE 8.7 Series.

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**SECTION 09 29 00**

**GYPSUM BOARD**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. 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 05 40 00, COLD-FORMED METAL FRAMING, and Section 09 22 16, NON- STRUCTURAL METAL FRAMING.
- B. Sound deadening board: Section 07 21 13, THERMAL INSULATION.
- C. Acoustical Sealants: Section 07 92 00, JOINT SEALANTS.
- D. Lay in gypsum board ceiling panels: Section 09 51 00, ACOUSTICAL CEILING.

**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.
2. Sound rating test.

**1.5 DELIVERY, IDENTIFICATION, HANDLING AND STORAGE**

- A. In accordance with the requirements of ASTM C840.

**1.6 ENVIRONMENTAL CONDITIONS**

- A. 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):

1. C11-08 Terminology Relating to Gypsum and Related Building Materials and Systems
2. C475-02 Joint Compound and Joint Tape for Finishing Gypsum Board
3. C840-08 Application and Finishing of Gypsum Board
4. C919-08 Sealants in Acoustical Applications
5. 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. in thickness
6. C1002-07 Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs
7. C1047-05 Accessories for Gypsum Wallboard and Gypsum Veneer Base
8. C1177-06 Glass Mat Gypsum Substrate for Use as Sheathing
9. C1396-06 Gypsum Board
10. E84-08 Surface Burning Characteristics of Building Materials

- C. Underwriters Laboratories Inc. (UL):
  - 1. Latest Edition Fire Resistance Directory
- D. Inchcape Testing Services (ITS):
  - 1. 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.
- B. Coreboard or Shaft Wall Liner Panels.
  - 1. ASTM C1396, Type X.
  - 2. 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. Paper facings shall contain 100 percent post-consumer recycled paper content.
- E. Abuse Resistant Gypsum Board: ASTM C1396/C1396M, Type X; 16 mm (5/8 inch) thick; and complying with ASTM C1629/C1629M as follows:
  - 1. Surface Abrasion Resistance: Level 2 or better.
  - 2. Indentation Resistance: Level 1 or better.
  - 3. Soft Body Impact Resistance: Level 2 or better.
  - 4. Hard Body Impact Resistance: Level 1 or better.

### **2.2 GYPSUM SHEATHING BOARD**

- A. ASTM C1177, 16 mm (5/8 inch), Type X, glass mat substrate, .

### **2.3 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.
- C. Firestop Putty Pads for Electrical Boxes: Listed intumescent moldable firestop putty pads
- D. Acoustic Putty Pads for Electrical Boxes: Asbestos-free, putty pads composed of polybutene-butyl and inert fillers

## **2.4 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.

## **2.5 FINISHING MATERIALS AND LAMINATING ADHESIVE**

- A. 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. Use gypsum boards in maximum practical lengths to minimize number of end joints.
- D. Bring gypsum board into contact, but do not force into place.
- E. 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.
- F. 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. No offset in exposed face of walls and partitions will be permitted because of single-ply and two-ply or three-ply application requirements.
  - 7. 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.

- G. Acoustical or Sound Rated Partitions, 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.
  3. For sound rated partitions, use sealing compound (ASTM C919) to fill the annular spaces between all receptacle boxes and the partition finish material through which the boxes protrude to seal all holes and/or openings on the back and sides of the boxes. STC minimum values as shown.
    - a. Install acoustic putty pads at all electrical boxes at non fire-resistance-rated walls.
    - b. Install firestop putty pads at all electrical boxes at fire-resistance-rated walls.
- H. 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 CAVITY SHAFT WALL**

- A. Coordinate assembly with Section 09 22 16, NON-STRUCTURAL METAL FRAMING, for erection of framing and gypsum board.
- B. Conform to FM WALL CONSTRUCTION 25- 1/HR (Non- loadbearing) for one-hour fire rating where shown.
- C. Cut coreboard (liner) panels 25 mm (one inch) less than floor-to-ceiling height, and erect vertically between J-runners on shaft side.
  - 1. Where shaft walls exceed 4300 mm (14 feet) in height, position panel end joints within upper and lower third points of wall.
  - 2. Stagger joints top and bottom in adjacent panels.
  - 3. After erection of J-struts of opening frames, fasten panels to J-struts with screws of sufficient length to secure to framing staggered from those in base, spaced 300 mm (12 inches) on center.
- D. Gypsum Board:
  - 1. One hour wall with one layer on finish side of wall: Apply face layer of gypsum board vertically. Attach to studs with screws of sufficient length to secure to framing, spaced 300 mm (12 inches) on center in field and along edges.
  - 2. Where coreboard is covered with face layer of gypsum board, stagger joints of face layer from those in the coreboard base.
- E. Treat joints, corners, and fasteners in face layer as specified for finishing of gypsum board.
- F. Elevator Shafts:
  - 1. Protrusions including fasteners other than flange of shaft wall framing system or offsets from vertical alignments more than 3 mm (1/8-inch) are not permitted unless shown.
  - 2. Align shaft walls for plumb vertical flush alignment from top to bottom of shaft.

### **3.5 FINISHING OF GYPSUM BOARD**

- A. Finish joints, edges, corners, and fastener heads in accordance with ASTM C840. Use Level 5 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, fire rated and sound 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 and sound 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 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.

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**SECTION 09 51 00**

**ACOUSTICAL CEILINGS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Metal ceiling suspension system for acoustical ceilings.
- B. Acoustical units.

**1.2 RELATED WORK**

- A. Color, pattern, and location of each type of acoustical unit:
  - 1. Section 09 06 00, SCHEDULE FOR FINISHES, and Drawing sheets AE 8.7 Series.
- B. Linear Wood Ceilings: Section 09 54 26, LINEAR WOOD CEILINGS.
- C. Acoustical Semi-Rigid Boards (Black-Faced): Section 07 21 13, THERMAL INSULATION.
- D. Access doors in adhesive applied tile: Section 08 31 13, ACCESS DOORS AND FRAMES.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Samples:
  - 1. Acoustical units, each type, with label indicating conformance to specification requirement,.
  - 2. Colored markers for units providing access.
- C. Manufacturer's Literature and Data:
  - 1. Ceiling suspension system, each type, showing complete details of installation.
  - 2. Acoustical units, each type
  - 3. Runners designed for snap-in attachment of metal pans.
- D. Manufacturer's Certificates: Acoustical units, each type, in accordance with specification requirements.

#### 1.4 DEFINITIONS

- A. Standard definitions as defined in ASTM C634.
- B. Terminology as defined in ASTM E1264.

#### 1.5 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 Society for Testing and Materials (ASTM):
  - 1. A641/A641M-03 Zinc-coated (Galvanized) Carbon Steel Wire
  - 2. A653/A653M-07 Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-coated (Galvannealed) by the Hot-Dip Process
  - 3. C423-07 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
  - 4. C634-02 (E2007) Standard Terminology Relating to Environmental Acoustics
  - 5. C635-04 Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
  - 6. C636-06 Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels
  - 7. E84-07 Surface Burning Characteristics of Building Materials
  - 8. E119-07 Fire Tests of Building Construction and Materials
  - 9. E413-04 Classification for Rating Sound Insulation.
  - 10. E580-06 Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Seismic Restraint
  - 11. E1264-(R2005) Classification for Acoustical Ceiling Products

### PART 2 - PRODUCTS

#### 2.1 METAL SUSPENSION SYSTEM

- A. ASTM C635, heavy-duty system, except as otherwise specified.
  - 1. Ceiling suspension system members may be fabricated from either of the following unless specified otherwise.
    - a. Galvanized cold-rolled steel, bonderized.
  - 2. Use same construction for cross runners as main runners. Use of lighter-duty sections for cross runners is not acceptable.

- B. Grid suspension system for support of lay-in panels: As indicated in Section 09 06 00, SCHEDULE FOR FINISHES.
  - 1. Fabricate wall molding and other special molding from the same material with same exposed width and finish as the exposed grid members.
  - 2. On exposed metal surfaces apply baked-on enamel flat texture finish in color to match adjacent acoustical units unless specified otherwise in Section 09 06 00, SCHEDULE FOR FINISHES.

## **2.2 PERIMETER SEAL**

- A. Vinyl, polyethylene or polyurethane open cell sponge material having density of 1.3 plus or minus 10 percent, compression set less than 10 percent with pressure sensitive adhesive coating on one side.
- B. Thickness as required to fill voids between back of wall molding and finish wall.
- C. Not less than 9 mm (3/8 inch) wide strip.

## **2.3 WIRE**

- A. ASTM A641.
- B. For wire hangers: Minimum diameter 2.68 mm (0.1055 inch).
- C. For bracing wires: Minimum diameter 3.43 mm (0.1350 inch).

## **2.4 ANCHORS AND INSERTS**

- A. Use anchors or inserts to support twice the loads imposed by hangers attached thereto.
- B. Hanger Inserts:
  - 1. Fabricate inserts from steel, zinc-coated (galvanized after fabrication).
- C. Clips:
  - 1. Galvanized steel.
  - 2. Designed to clamp to steel beam or bar joists, or secure framing member together.
  - 3. Designed to rigidly secure framing members together.
  - 4. Designed to sustain twice the loads imposed by hangers or items supported.
- D. Tile Splines: ASTM C635.

## 2.5 CARRYING CHANNELS FOR SECONDARY FRAMING

- A. Fabricate from cold-rolled or hot-rolled steel, black asphaltic paint finish, free of rust.
- B. Weighing not less than the following, per 300 m (per thousand linear feet):

Size mm	Size Inches	Cold-rolled		Hot-rolled	
		Kg	Pound	Kg	Pound
38	1 1/2	215.4	475	508	1120
50	2	267.6	590	571.5	1260

## 2.6 ACOUSTICAL UNITS

- A. General:
1. ASTM E1264, weighing 3.6 kg/m<sup>2</sup> (3/4 psf) minimum for mineral fiber panels or tile.
  2. Class A Flame Spread: ASTM 84
  3. Minimum NRC (Noise Reduction Coefficient): 0.70 unless specified otherwise: ASTM C423.
  4. Minimum CAC (Ceiling Attenuation Class): 30-40 range unless specified otherwise: ASTM E413.
  5. Manufacturers standard finish, minimum Light Reflectance (LR) coefficient of 0.75 on the exposed surfaces, except as specified otherwise in Section 09 06 00, SCHEDULE FOR FINISHES.
  6. Lay-in panels: Sizes as shown, with square edges and reveal edges as specified in Section 09 06 00, SCHEDULE FOR FINISHES.
- B. Type IV Units - Mineral base with membrane-faced overlay, Form 2 - Water felted, minimum 16 mm (5/8 inch) thick. Apply over the paint coat on the face of the unit a poly (vinyl) chloride overspray having a flame spread index of 25 or less when tested in accordance with ASTM E84.
- C. Monolithic appearance large format panels, semi-concealed suspension with nominal 6 mm (1/4 inch reveals).
1. Swing-down access to plenum area.
  2. Sag-free construction.
  3. Minimum NRC: 0.85.
  4. Size: As indicated on Drawings.
  5. Color and Finish: As specified in Section 09 0600, SCHEDULE FOR FINISHES.

## 2.7 ACCESS IDENTIFICATION

### A. Markers:

1. Use colored markers with pressure sensitive adhesive on one side.
2. Make colored markers of paper or plastic, 6 to 9 mm (1/4 to 3/8 inch) in diameter.

### B. Use markers of the same diameter throughout building.

### C. Color Code: Use following color markers for service identification:

- |           |  |
|-----------|--|
| 1. Color  | Service                                  |
| 2. Red    | Sprinkler System: Valves and Controls    |
| 3. Green  | Domestic Water: Valves and Controls      |
| 4. Yellow | Chilled Water and Heating Water          |
| 5. Orange | Ductwork: Fire Dampers                   |
| 6. Blue   | Ductwork: Dampers and Controls           |
| 7. Black  | Gas: Laboratory, Medical, Air and Vacuum |

## PART 3 - EXECUTION

### 3.1 CEILING TREATMENT

- #### A. Treatment of ceilings shall include sides and soffits of ceiling beams, furred work 600 mm (24 inches) wide and over, and vertical surfaces at changes in ceiling heights unless otherwise shown. Install acoustic tiles after wet finishes have been installed and solvents have cured.
- #### B. Lay out acoustical units symmetrically about center lines of each room or space unless shown otherwise on reflected ceiling plan.
- #### C. 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.
- #### D. 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.

E. Existing ceiling:

1. Where extension of existing ceilings occur, 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.

F. Fire-Rated System:

1. Total assembly, consisting of the ceiling suspension system, acoustical units, penetrations, structural components and floor or roof construction above, shall have a [ 1 hour ] [ 2 hour ] [ 3 hour ] fire rating based on tests conducted in conformance with ASTM E119.
2. Provide concealed fire protection around penetrations in ceilings for electric and mechanical work, and other penetrations as required to maintain the integrity of the fire-rated assembly.
3. Install fire rated ceiling systems to conform to tested assembly.

### 3.2 CEILING SUSPENSION SYSTEM INSTALLATION

A. General:

1. Install metal suspension system for acoustical tile and lay-in panels in accordance with ASTM C636, except as specified otherwise.
2. Use direct or indirect hung suspension system or combination thereof as defined in ASTM C635.
3. Support a maximum area of 1.48 m<sup>2</sup> (16 sf) of ceiling per hanger.
4. Prevent deflection in excess of 1/360 of span of cross runner and main runner.
5. Provide extra hangers, minimum of one hanger at each corner of each item of mechanical, electrical and miscellaneous equipment supported by ceiling suspension system not having separate support or hangers.
6. Provide not less than 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,
7. Use main runners not less than 1200 mm (48 inches) in length.
8. Install hanger wires vertically. Angled wires are not acceptable except for seismic restraint bracing wires.

B. Anchorage to Structure:

1. Concrete:
  - a. Install hanger inserts and wire loops required for support of hanger [ **and bracing** ] wire in concrete forms before concrete is placed. Install hanger wires with looped ends through steel deck if 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 [and bracing] wire. Install in sides of concrete beams or joists at mid height.
2. Steel:
    - a. **When steel framing does not permit installation of hanger wires at spacing required, install carrying channels for attachment of hanger wires.**
      - 1) Size and space carrying channels to insure that the maximum deflection specified will not be exceeded.
      - 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 fire proofing is installed. Weld or use steel clips to attach to beam to develop full strength of carrying channel.
    - 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.
- C. Direct Hung Suspension System:
1. As illustrated in ASTM C635.
  2. Support main runners by hanger wires attached directly to the structure overhead.
  3. 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.
- D. Indirect Hung Suspension System:
1. As illustrated in ASTM C635.
  2. Space carrying channels for indirect hung suspension system not more than 1200 mm (4 feet) on center. Space hangers for carrying channels not more than 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.
  3. Support main runners by specially designed clips attached to carrying channels.
- E. Seismic Ceiling Bracing System:
1. Construct system in accordance with ASCE 7-05 and CISCA'S "Guidelines for Seismic Restraint of Direct-Hung Suspended Ceiling Assemblies - Seismic Zones 3 & 4".
  2. Connect bracing wires to structure above as specified for anchorage to structure and to main runner or carrying channels of suspended ceiling at bottom.



### 3.3 ACOUSTICAL UNIT INSTALLATION

- A. Cut acoustic units for perimeter borders and penetrations to fit tight against penetration for joint not concealed by molding.
- B. Install lay-in acoustic panels in exposed grid with not less than 6 mm (1/4 inch) bearing at edges on supports.
  - 1. Install tile to lay level and in full contact with exposed grid.
  - 2. Replace cracked, broken, stained, dirty, or tile not cut for minimum bearing.
- C. Markers:
  - 1. Install markers of color code specified to identify the various concealed piping, mechanical, and plumbing systems.
  - 2. Attach colored markers to exposed grid on opposite sides of the units providing access.
  - 3. Attach marker on exposed ceiling surface of upward access acoustical unit.

### 3.4 CLEAN-UP AND COMPLETION

- A. Replace damaged, discolored, dirty, cracked and broken acoustical units.
- B. Leave finished work free from defects.

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**SECTION 09 64 00**

**WOOD FLOORING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specified the installation of factory-finished engineered wood flooring.

**1.2 RELATED WORK**

- A. Substrate for wood flooring Section 03 30 00, CAST-IN-PLACE CONCRETE.

**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. Description of each product.
  2. Wood flooring manufacturers' adhesive recommendations.
  3. Application and installation instructions.
- C. Samples: For each type of wood flooring and accessory, with stain color and finish required, approximately 300 mm (12 inches) long and of same thickness and material indicated for the Work and showing the full range of normal color and variations expected.
- D. Shop Drawings:
1. Layout of patterns shown on the drawings and in Section 09 06 00, SCHEDULE FOR FINISHES.

**1.4 QUALITY ASSURANCE**

- A. Hardwood Flooring: Comply with NOFMA's "Official Flooring Grading Rules" for species, grade, and cut.
- B. Mockups: Install mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. To set quality standards for installation, install mockup of floor area as directed by Resident Engineer.
  2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

**1.5 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 will be rejected.

**1.6 STORAGE**

- A. Store materials in weathertight and dry storage facility.
- B. Protect from damage from handling, water, and temperature.

**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):
  - 1. F1869-04 Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
- C. Hardwood Plywood Veneer Association (HPVA):
  - 1. HPVA EF-2002 American National Standard for Engineered Wood Flooring
- D. National Wood Flooring Association (NWFA):
  - 1. Installation Guidelines: Wood Flooring

**PART 2 - PRODUCTS**

**2.1 FACTORY-FINISHED WOOD FLOORING**

- A. Engineered-Wood, Plank Flooring: HPVA EF, except bonding agent contains no urea formaldehyde.
  - 1. Species: *Astronium Fraxinifolium* common name Tigerwood.
  - 2. Thickness: 15.6 mm (5/8 inch).
  - 3. Face Width: 91 mm (3-1/2 inches).
  - 4. Lengths: Random-length strips 304.8 mm -1193.8 mm (12 - 47 inches).
  - 5. Construction: Minimum five ply.
  - 6. Edge/Ends Style: Micro-Beveled (eased) edges and ends.
  - 7. Finish: Acrylic impregnated.
  - 8. Color: As indicated in Section 09 06 00, SCHEDULE FOR FINISHES.

## 2.2 ACCESSORY MATERIALS

- A. Wood Flooring Adhesive: Mastic recommended by flooring and adhesive manufacturers for application indicated.
  - 1. Use adhesives that have a VOC content of not more than 100 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by wood flooring manufacturer.

## PART 3 - EXECUTION

### 3.1 PROJECT CONDITIONS

- A. Do not install flooring until building is permanently enclosed and wet construction in or near areas to receive wood flooring is complete, dry and cured.
- B. Conditioning period begins not less than seven days before wood flooring installation, is continuous through installation, and continues not less than seven days after wood flooring installation.
  - 1. Environmental Conditioning: Maintain an ambient temperature between 65 and 75 deg F (18 and 24 deg C) and relative humidity planned for building occupants in spaces to receive wood flooring during the conditioning period.
  - 2. Wood Flooring Conditioning: Move wood flooring into spaces where it will be installed, no later than the beginning of the conditioning period.
    - a. Do not install flooring until it adjusts to relative humidity of, and is at same temperature as, space where it is to be installed.
    - b. Open sealed packages to allow wood flooring to acclimatize immediately on moving flooring into spaces in which it will be installed.
- C. After conditioning period, maintain relative humidity and ambient temperature planned for building occupants.
- D. Install factory-finished wood flooring after other finishing operations, including painting, have been completed.

### 3.2 SUBFLOOR PREPARATION

- A. Examine substrates, areas and conditions, with Installer present, for compliance with requirements for maximum moisture content, installation tolerances, and other conditions affecting performance of wood flooring.
  - 1. Verify that substrates comply with tolerances and other requirements specified in other Sections.

2. For adhesively applied wood flooring, verify that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
  3. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Substrate Moisture Testing, General: Perform tests recommended by manufacturer or, if none, comply with applicable recommendations in NWFA's "Installation Guidelines: Wood Flooring."
1. Proceed with installation only after substrates pass testing.
- C. Concrete Moisture Testing: Perform anhydrous calcium chloride test per ASTM F 1869, as follows:
1. Perform tests so that each test area does not exceed 18.6 sq. m (200 sq. ft.) and perform not less than 2 tests in each installation area with test areas evenly spaced in installation area.
  2. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 1.36 kg of water/92.9 sq. m) (3 lb of water/1000 sq. ft.) in 24 hours.
  3. Perform alkalinity and adhesion tests recommended in writing by manufacturer or, if none, according to NWFA's "Installation Guidelines: Wood Flooring." Proceed with installation only after substrates pass testing.
- D. Correct conditions which will impair proper installation.
- E. Grind high spots and fill low spots on concrete substrates to produce a maximum 3 mm (1/8 inch) deviation in any direction when checked with a 3 m (10 foot) straight edge.
- F. Remove coatings, including curing compounds, and other substances on substrates that are incompatible with installation adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- G. Fill cracks, joints and other irregularities in concrete with leveling compound:
1. Do not use adhesive for filling or leveling purposes.
  2. Do not use leveling compound to correct imperfections which can be corrected by spot grinding.
  3. Trowel to smooth surface free of trowel marks, pits, dents, protrusions, cracks or joints.
- H. Clean floor of oil, paint, dust, and deleterious substances: Leave floor dry and cured free of residue from existing curing or cleaning agents.
- I. Broom or vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.3 INSTALLATION**

- A. Comply with flooring manufacturer's written installation instructions, but not less than applicable recommendations in NWFA's "Installation Guidelines: Wood Flooring."
- B. Provide expansion space at walls and other obstructions and terminations of flooring as recommended by manufacturer, but not less than 6 mm (1/4 inch).
- C. Engineered-Wood Flooring: Set in adhesive.

**3.4 PROTECTION**

- A. Protect installed wood flooring during remainder of construction period with covering of heavy kraft paper or other suitable material. Do not use plastic sheet or film that might cause condensation.
  - 1. Do not move heavy and sharp objects directly over kraft-paper-covered wood flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

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**SECTION 09 65 13**

**RESILIENT BASE AND ACCESSORIES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the installation of vinyl or rubber base and resilient stair treads with sheet rubber flooring on landings.

**1.2 RELATED WORK**

- A. Color and texture: Section 09 06 00, SCHEDULE FOR FINISHES.
- B. Integral base with sheet flooring: Section 09 65 16, RESILIENT SHEET FLOORING.

**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. Description of each product.
  - 2. Base and stair material manufacturer's recommendations for adhesives.
  - 3. Application and installation instructions.
- C. Samples:
  - 1. Base: 150 mm (6 inches) long, each type and color.
  - 2. Adhesive: Literature indicating each type.

**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 will be rejected.

**1.5 STORAGE**

- A. Store materials in weather tight and dry storage facility.
- B. Protect material from damage by handling and construction operations before, during, and after installation.



## **1.6 APPLICABLE PUBLICATIONS**

- A. The publication 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):
  - 1. F1861-02 Resilient Wall Base

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. Use only products by the same manufacturer and from the same production run.

### **2.2 RESILIENT BASE**

- A. ASTM F1861, 3 mm (1/8 inch) thick, 100 mm (4 inches) high, Type TP Rubber, Thermoplastics, Group 2-layered with molded top. Style B-cove.
- B. Where carpet occurs, use Style A-straight.
- C. Use only one type of base throughout.

### **2.3 ADHESIVES**

- A. Use products recommended by the material manufacturer for the conditions of use.
- B. Use low-VOC adhesive during installation. Water based adhesive with low VOC is preferred over solvent based adhesive.

## **PART 3 - EXECUTION**

### **3.1 PROJECT CONDITIONS**

- A. Maintain temperature of materials above 21° C (70° F), for 48 hours before installation.
- B. Maintain temperature of rooms where work occurs, between 21° C and 27° C (70° F and 80° F) for at least 48 hours, before, during, and after installation.
- C. Do not install materials until building is permanently enclosed and wet construction is complete, dry, and cured.

### **3.2 INSTALLATION REQUIREMENTS**

- A. The respective manufacturer's instructions for application and installation will be considered for use when approved by the Resident

Engineer.

- B. Submit proposed installation deviation from this specification to the Resident Engineer indicating the differences in the method of installation.
- C. The Resident Engineer reserves the right to have test portions of material installation removed to check for non-uniform adhesion and spotty adhesive coverage.

### **3.3 PREPARATION**

- A. Examine surfaces on which material is to be installed.
- B. Fill cracks, pits, and dents with leveling compound.
- C. Level to 3 mm (1/8 inch) maximum variations.
- D. Do not use adhesive for leveling or filling.
- E. Grind, sand, or cut away protrusions; grind high spots.
- F. Clean substrate area of oil, grease, dust, paint, and deleterious substances.
- G. Substrate area dry and cured. Perform manufacturer's recommended bond and moisture test.
- H. Preparation of existing installation:
  - 1. Remove existing base and stair treads including adhesive.
  - 2. Do not use solvents to remove adhesives.
  - 3. Prepare substrate as specified.

### **3.4 BASE INSTALLATION**

- A. Location:
  - 1. Unless otherwise specified or shown, where base is scheduled, install base over toe space of base of casework, lockers, laboratory, pharmacy furniture island cabinets and where other equipment occurs.
  - 2. Extend base scheduled for room into adjacent closet, alcoves, and around columns.
- B. Application:
  - 1. Apply adhesive uniformly with no bare spots.
  - 2. Set base with joints aligned and butted to touch for entire height.
  - 3. Before starting installation, layout base material to provide the minimum number of joints with no strip less than 600 mm (24 inches) length.
    - a. Short pieces to save material will not be permitted.
    - b. Locate joints as remote from corners as the material lengths or

the wall configuration will permit.

- C. Form corners and end stops as follows:
  - 1. Score back of outside corner.
  - 2. Score face of inside corner and notch cove.
- D. Roll base for complete adhesion.

### 3.5 CLEANING AND PROTECTION

- A. Clean all exposed surfaces of base and adjoining areas of adhesive spatter before it sets.
- B. Keep traffic off resilient material for at least 72 hours after installation.
- C. Clean and polish materials in the following order:
  - 1. After two weeks, scrub resilient base, sheet rubber and treads materials with a minimum amount of water and a mild detergent. Leave surfaces clean and free of detergent residue. Polish resilient base to a gloss finish.
  - 2. Do not polish tread and sheet rubber materials.
- D. When construction traffic is anticipated, cover tread materials with reinforced kraft paper and plywood or hardboard properly secured and maintained until removal is directed by the Resident Engineer.
- E. Where protective materials are removed and immediately prior to acceptance, replace damaged materials and re-clean resilient materials. Damaged materials are defined as having cuts, gouges, scrapes or tears and not fully adhered.

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**SECTION 09 65 16**

**RESILIENT SHEET FLOORING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section specifies the installation of sheet flooring with backing and integral cove base.
- B. Grades of resilient sheet vinyl floor covering without backing having vinyl plastic wear layer with backing.
- C. Installation of sheet flooring including following:
  - 1. Heat welded seams.
  - 2. Integral cove base: Installed at intersection of floor and vertical surfaces.

**1.2 RELATED WORK**

- A. Concrete floors: Section 03 30 00, CAST-IN-PLACE CONCRETE.
- B. Color, pattern and texture: Section 09 06 00, SCHEDULE FOR FINISHES.
- C. Resilient base over base of lockers, equipment and casework: Section 09 65 13, RESILIENT BASE AND ACCESSORIES.
- D. Unbacked vinyl (homogenous) sheet flooring with welded seams: Section 09 65 16, RESILIENT SHEET FLOORING.

**1.3 QUALITY CONTROL - QUALIFICATIONS:**

- A. The Contracting Officer shall approve products or service of proposed manufacturer, suppliers, and installers, and the Contractor shall submit certification that:
  - 1. Heat welded seaming is manufacturer's prescribed method of installation.
  - 2. Installer is approved by manufacturer of materials and has technical qualifications, experience, trained personnel, and facilities to install specified items.
  - 3. Manufacturer's product submitted has been in satisfactory operation, on three installations similar and equivalent in size to this project for three years. Submit list of installations.
- B. The sheet vinyl floor coverings shall meet fire performance characteristics as determined by testing products, per ASTM test method, indicated below by Underwriters Laboratories, Inc. or another recognized testing and inspecting agency acceptable to authorities having jurisdiction.
  - 1. Critical Radiant Flux: 0.45 watts per sq. cm or more, Class I, per ASTM E648.

2. Smoke Density: Less than 450 per ASTM E662.
3. Static Coefficient of Friction: For resilient sheet flooring installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 2047:
  - a. Level Surfaces: Minimum 0.6.
  - b. Ramp Surfaces: Minimum 0.8.
- C. The floor covering manufacturer shall certify that products supplied for installation comply with local regulations controlling use of volatile organic compounds (VOC's).

#### **1.4 SUBMITTALS**

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, submit following:
- B. Manufacturer's Literature and Data:
  1. Description of resilient material and accessories to be provided.
  2. Resilient material manufacturer's recommendations for adhesives, weld rods, sealants, and underlayment.
  3. Application and installation instructions.
- C. Samples:
  1. Sheet material, 38 mm by 300 mm (1-1/2 inch by 12 inch), of each color and pattern with a welded seam using proposed welding rod 300 mm (12 inches) square for each type, pattern and color.
  2. Cap strip and fillet strip, 300 mm (12 inches) for integral base.
  3. Shop Drawings and Certificates: Layout of joints showing patterns where joints are expressed, and type and location of obscure type joints. Indicate orientation of directional patterns.
  4. Certificates: Quality Control Certificate Submittals and lists specified in paragraph, QUALIFICATIONS.
  5. Edge strips: 150 mm (6 inches) long each type.
  6. Adhesive, underlayment and primer: Pint container, each type.

#### **1.5 PROJECT CONDITIONS**

- A. Maintain temperature of floor materials and room, where work occurs, above 18° C (65° F) and below 38° C (100° F) for 48 hours before, during and for 48 hours after installation. After above period, room temperature shall not fall below 13° C (55° F).
- B. Construction in or near areas to receive flooring work shall be complete, dry and cured. Do not install resilient flooring over slabs until they have been cured and are sufficiently dry to achieve a bond with adhesive. Follow flooring manufacturer's recommendations for bond and moisture testing.

- C. Building shall be permanently enclosed. Schedule construction so that floor receives no construction traffic when completed.

#### **1.6 DELIVERY, STORAGE AND HANDLING**

- A. Deliver materials to site in original sealed packages or containers; labeled for identification with manufacturer's name and brand.
- B. Deliver sheet flooring full width roll, completely enclosed in factory wrap, clearly marked with the manufacturer's number, type and color, production run number and manufacture date.
- C. Store materials in weathertight and dry storage facility. Protect from damage due to handling, weather, and construction operations before, during and after installation. Store sheet flooring on end with ambient temperatures maintained as recommended by manufacturer.
- D. Store sheet flooring on end.
- E. Move sheet vinyl floor coverings and installation accessories into spaces where they will be installed at least 48 hours in advance of installation.

#### **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. American Society For Testing Materials (ASTM):
  - 1. E648-06 Critical Radiant Flux of Floor-Covering Systems Using a Radiant Energy Source.
  - 2. E662-06 Specific Optical Density of Smoke Generated by Solid Materials.
  - 3. E1907-06 Evaluating Moisture Conditions of Concrete Floors to Receive Resilient Floor Coverings
  - 4. F710-05 Practice for Preparing Concrete Floors and Other Monolithic Floors to Receive Resilient Flooring.
  - 5. F1303-04 Sheet Vinyl Floor Covering with Backing.
  - 6. F1913-04 Sheet Vinyl Flooring without Backing
- C. Resilient Floor Covering Institute (RFCI):
  - 1. Recommended Work Practices for Removal of Resilient Floor Coverings.

#### **1.8 SCHEDULING**

- A. Interior finish work such as plastering, drywall finishing, concrete, terrazzo, ceiling work, and painting work shall be complete and dry before installation. Mechanical, electrical, and other work above ceiling line shall be completed. Heating, ventilating, and air conditioning systems shall be installed and operating in order to maintain temperature and humidity requirements.

**1.9 WARRANTY:**

- A. Submit written warranty, in accordance with FAR clause 52.246-21, Warranty of Construction requirements except that warranty period shall be extended to include two (2) years.

**PART 2 - PRODUCTS**

**2.1 SHEET VINYL FLOOR COVERINGS**

- A. Sheet Vinyl Floor Coverings: Smooth face, minimum thickness nominal
- B. 2 mm (0.08 inch). Sheet flooring shall conform to ASTM F1913 and material requirements specified in ASTM F1303, Type I, Grade 1, backing Class B. Foam backed sheet flooring is not acceptable.
- C. Each color and pattern of sheet flooring shall be of same production run.

**2.2 WELDING ROD:**

- A. Product of floor covering manufacturer in color shall match field color of sheet vinyl covering.

**2.3 APPLICATION MATERIALS AND ACCESSORIES**

- A. Floor and Base Adhesive: Type recommended by sheet flooring material manufacturer for conditions of use.
- B. Mastic Underlayment (for concrete floors): Provide products with latex or polyvinyl acetate resins in mix. Condition to be corrected shall determine type of underlayment selected for use.

**2.4 SHEET FLOORING**

- A. ASTM F1303, Type II, Grade 1, except for backing requirements. Foam backed sheet flooring is not acceptable.
- B. Minimum nominal thickness 2 mm (0.08 inch); 1800 mm (6 ft) minimum width.
- C. Critical Radiant Flux: 0.45 watts per sq.cm or more, Class I, per ASTM E648.
- D. Smoke density: less than 450 per ASTM E662.
- E. Color and pattern of sheet flooring of the same production run.

**2.5 ADHESIVES**

- A. Water resistant type recommended by the sheet flooring manufacturer for the conditions of use.

**2.6 BASE CAP STRIP AND COVE STRIP**

- A. Extruded vinyl compatible with the sheet flooring.

- B. Cap strip "J" shape with feathered edge flange approximately 25 mm (one inch) wide; top designed to receive sheet flooring with 13 mm (1/2 inch) flange lapping top of flooring
- C. Cove strip 70 mm (2-3/4 inch) radius.

#### **2.7 LEVELING COMPOUND (FOR CONCRETE FLOORS)**

- A. Provide cementitious products with latex or polyvinyl acetate resins in the mix.

#### **2.8 PRIMER (FOR CONCRETE SUBFLOORS)**

- A. As recommended by the adhesive or sheet flooring manufacturer.

#### **2.9 EDGE STRIPS**

- A. Extruded aluminum, mill finish, mechanically cleaned.
- B. 28 mm (1-1/8 inch) wide, 6 mm (1/4 inch) thick, bevel one edge to 3 mm (1/8 inch) thick.
- C. Drill and counter sink edge strips for flat head screws. Space holes near ends and approximately 225 mm (9 inches) on center in between.

### **PART 3 - EXECUTION**

#### **3.1 PROJECT CONDITIONS**

- A. Maintain temperature of sheet flooring above 36 °C (65 °F), for 48 hours before installation.
- B. Maintain temperature of rooms where sheet flooring work occurs above 36° C (65° F), for 48 hours, before installation and during installation.
- C. After installation, maintain temperature at or above 36° C □65° F.□
- D. Building is permanently enclosed.
- E. Wet construction in or near areas to receive sheet flooring is complete, dry and cured.

#### **3.2 SUBFLOOR PREPARATION**

- A. Concrete Subfloors: Verify that concrete slabs comply with ASTM F710.
  - 1. Installer shall examine surfaces on which resilient sheet flooring is to be installed, and shall advise Contractor, in writing, of areas which are unacceptable for installation of flooring material. Installer shall advise Contractor which methods are to be used to correct conditions that will impair proper installation. Installation shall not proceed until unsatisfactory conditions have been corrected.



2. Slab substrates dry, free of curing compounds, sealers, hardeners, and other materials which would interfere with bonding of adhesive. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by Resilient Floor Covering Institute recommendations in manual RFCI-MRP.
- B. Broom or vacuum clean substrates to be covered by sheet vinyl floor coverings immediately before installation. Following cleaning, examine substrates to determine if there is visually any evidence of moisture, alkaline salts, carbonation, or dust.
- C. Primer: If recommended by flooring manufacturer, prior to application of adhesive, apply concrete slab primer in accordance with manufacturer's directions.
- D. Correct conditions which will impair proper installation, including trowel marks, pits, dents, protrusions, cracks or joints.
- E. Fill cracks, joints, depressions, and other irregularities in concrete with leveling compound.
  1. Do not use adhesive for filling or leveling purposes.
  2. Do not use leveling compound to correct imperfections which can be corrected by spot grinding.
  3. Trowel to smooth surface free of trowel marks, pits, dents, protrusions, cracks or joint lines.
- F. Clean floor of oil, paint, dust and deleterious substances. Leave floor dry and cured free of residue from existing curing or cleaning agents.
- G. Concrete Subfloor Testing:
  1. Determine adhesion and dryness of the floor by bond and moisture tests as recommended by RFCI manual MRP.
- H. Preparation shall include the removal of existing resilient floor and existing adhesive. Do not use solvents to remove adhesives. Coordinate with Asbestos Abatement Section if asbestos abatement procedures will be involved.
- I. Remove existing resilient flooring and adhesive completely in accordance with Resilient Floor Covering Institute recommendations in manual RFCI-WP. Solvents shall not be used.

### **3.3 INSTALLATION OF FLOORING**

- A. Install work in strict compliance with manufacturer's instructions and approved layout drawings.
- B. Maintain uniformity of sheet vinyl floor covering direction and avoid cross seams.

- C. Arrange for a minimum number of seams and place them in inconspicuous and low traffic areas, but in no case less than 150 mm (6 inches) away from parallel joints in flooring substrates.
- D. Match edges of resilient floor coverings for color shading and pattern at seams.
- E. Where resilient sheet flooring abuts other flooring material floors shall finish level.
- F. Extend sheet vinyl floor coverings into toe spaces, door reveals, closets, and similar openings.
- G. Inform the Resident Engineer of conflicts between this section and the manufacturer's instructions or recommendations for auxiliary materials, or installation methods, before proceeding.
- H. Install sheet in full coverage adhesives.
  - 1. Air pockets or loose edges will not be accepted.
  - 2. Trim sheet materials to touch in the length of intersection at pipes and vertical projections; seal joints at pipe with waterproof cement or sealant.
- I. Keep joints to a minimum; avoid small filler pieces or strips.
- J. Follow manufacturer's recommendations for seams at butt joints. Do not leave any open joints that would be readily visible from a standing position.
- K. Follow manufacturer's recommendations regarding pattern match, if applicable.
- L. Installation of Edge Strips:
  - 1. Locate edge strips under center lines of doors unless otherwise indicated.
  - 2. Set aluminum strips in adhesive, anchor with lead anchors and stainless steel Phillips screws.
- M. Integral Cove Base Installation:
  - 1. Set preformed fillet strip to receive base.
  - 2. Install the base with adhesive, terminate expose edge with the cap strip.
  - 3. Form internal and external corners to the geometric shape generated by the cove at either straight or radius corners.
  - 4. Solvent weld joints as specified for the flooring. Seal cap strip to wall with an adhesive type sealant.
  - 5. Unless otherwise specified or shown where sheet flooring is scheduled, provide integral base at intersection of floor and vertical surfaces. Provide sheet flooring and base scheduled for room on floors and walls under and behind areas where casework, laboratory and pharmacy

furniture and other equipment occurs, except where mounted in wall recesses.

### **3.4 INSTALLATION OF INTEGRAL COVERED BASE**

- A. Set preformed cove to receive base. Install base material with adhesive and terminate exposed edge with cap strip. Integral base height as shown on the Drawings.
- B. Internal and external corners shall be formed to geometric shape generated by cove at either square or radius corners.

### **3.5 WELDING**

- A. Heat weld all joints of flooring and base using equipment and procedures recommended by flooring manufacturer.
- B. Welding shall consist of routing joint, inserting a welding rod into routed space, and terminally fusing into a homogeneous joint.
- C. Upon completion of welding, surface across joint shall finish flush, free from voids, and recessed or raised areas.
- D. Fusion of Material: Joint shall be fused a minimum of 65 percent through thickness of material, and after welding shall meet specified characteristics for flooring.

### **3.6 CLEANING**

- A. Clean small adhesive marks during application of sheet flooring and base before adhesive sets, excessive adhesive smearing will not be accepted.
- B. Remove visible adhesive and other surface blemishes using methods and cleaner recommended by floor covering manufacturers.
- C. Clean and polish materials per flooring manufacturer's written recommendations.
- D. Vacuum floor thoroughly.
- E. Do not wash floor until after period recommended by floor covering manufacturer and then prepare in accordance with manufacturer's recommendations.
- F. Upon completion, Resident Engineer shall inspect floor and base to ascertain that work was done in accordance with manufacturer's printed instructions.
- G. Perform initial maintenance according to flooring manufacturer's written recommendations.

**3.7 PROTECTION:**

- A. Protect installed flooring as recommended by flooring manufacturer against damage from rolling loads, other trades, or placement of fixtures and furnishings.
- B. Keep traffic off sheet flooring for 24 hours after installation.
- C. Where construction traffic is anticipated, cover sheet flooring with reinforced kraft paper properly secured and maintained until removal is authorized by the Resident Engineer.
- D. Where protective materials are removed and immediately prior to acceptance, repair any damage, re-clean sheet flooring, lightly re-apply polish and buff floor.

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**SECTION 09 65 36**

**STATIC-CONTROL RESILIENT FLOORING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the installation of static-dissipative, vinyl composition floor tile.

**1.2 RELATED WORK**

- A. Color and pattern and location in room finish schedule: Section 09 06 00, SCHEDULE FOR FINISHES.

**1.3 QUALITY CONTROL - QUALIFICATIONS**

- A. The Contracting Officer shall approve products or service of proposed manufacturer, suppliers, and installers, and the Contractor shall submit certification that:
1. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
    - a. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
  2. Smoke Density: Less than 450 per ASTM E662.
  3. Static Coefficient of Friction: For resilient sheet flooring installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 2047:
    - a. Level Surfaces: Minimum 0.6.
    - b. Ramp Surfaces: Minimum 0.8.

**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. Description of each product.
  2. Static-dissipative vinyl composition floor tile material manufacturer's recommendations for adhesives, underlayment, primers and maintenance information.
  3. Application and installation instructions.

- C. Shop Drawings: For each type of floor covering. Include floor covering layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
  - 1. Show details of special patterns.
  - 2. Submit grounding diagram showing location of grounding strips and connections.
- D. Samples: For each type of floor covering indicated and of size indicated below:
  - 1. Floor Tile: Full-size units.
- E. Qualification Data: For qualified Installer.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of floor covering to include in maintenance manuals.

#### 1.6 PERFORMANCE REQUIREMENTS

- A. Static-Dissipative Properties: Provide floor coverings with static-control properties indicated as determined by testing identical products per test method indicated by an independent testing and inspecting agency.
  - 1. Electrical Resistance: Test per ASTM F 150 with 100-V applied voltage and ESD-STM-7.1.
    - a. Average no less than 1 megohm and less than or equal to 1000 megohms when installed floor coverings are tested surface to ground.
  - 2. Static Decay: 5000 to 0 V in less than 0.5 seconds when tested per FED-STD-101C/4046.1.

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor covering installation indicated.
  - 1. Engage an installer who employs workers for this Project who are trained or certified by manufacturer for installation techniques required.
- B. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
  - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Build mockups for floor coverings including accessories.

- a. Size: Minimum 100 sq. ft. (9.3 sq. m) for each type, color, and pattern in locations directed by Resident Engineer.

D. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to static-control resilient floor coverings including, but not limited to, the following:
  - a. Examination and preparation of substrates to receive floor covering.
  - b. Field quality-control testing.

#### **1.8 DELIVERY, STORAGE, AND HANDLING**

- 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 will be rejected.
- C. Store floor coverings and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).
  1. Floor Tile: Store on flat surfaces.

#### **1.9 PROJECT CONDITIONS**

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 85 deg F (29 deg C), in spaces to receive floor coverings during the following time periods:
  1. 48 hours before installation.
  2. During installation.
  3. 48 hours after installation.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Close spaces to traffic during floor covering installation.
- D. Close spaces to traffic for 48 hours after floor covering installation.
- E. Install floor coverings after other finishing operations, including painting, have been completed.

#### **1.10 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.

- B. American Society for Testing and Materials (ASTM):
  - 1. ASTM F 150 Standard Test Method for Electrical Resistance of Conductive and Static Dissipative Resilient Flooring
  - 2. ASTM F 710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
  - 3. ASTM F 1066 Standard Specification for Vinyl Composition Floor Tile
  - 4. ASTM F 1869 Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
- C. American National Standards Institute (ANSI):
  - 1. ANSI/ESD-STM-7.1 Standard for the Protection of Electrostatic Discharge Susceptible Items - Floor Materials - Characterization of Materials
- D. Federal Standards (FED-STD):
  - 1. FED-STD-101C/4046.1 Test Procedures for Packaging Materials

## **PART 2 - PRODUCTS**

### **2.1 STATIC-DISSIPATIVE RESILIENT FLOOR COVERINGS**

- A. Static-Dissipative, Vinyl Composition Floor Tile: ASTM F 1066 (vinyl composition floor tile, nonasbestos formulated), Class 2 (through-pattern tile).
  - 1. Thickness: Not less than 0.125 inch (3.2 mm).
  - 2. Size: 12 by 12 inches (305 by 305 mm).
  - 3. Colors and Patterns: As specified in Section 09 06 00, SCHEDULE FOR FINISHES.

### **2.2 INSTALLATION MATERIALS**

- A. Static-Control Adhesive: Provided or approved by manufacturer; type that maintains electrical continuity of floor covering system to ground connection.
  - 1. Adhesives shall comply with the following limits for VOC content when calculated according to 40 CFR, Subpart D (EPA Method 24):
    - a. VCT Adhesives: Not more than 50 g/L.
- B. Grounding Strips: Provided or approved by manufacturer; type and size that maintains electrical continuity of floor covering system to ground connection.



### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion or static-control characteristics of floor coverings.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of floor coverings and electrical continuity of floor covering systems.
- B. Concrete Substrates: Prepare according to ASTM F 710.
  - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  - 2. Remove substrate coatings and other substances that are incompatible with floor covering adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
  - 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
  - 4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.
    - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
- C. Do not install floor coverings until they are same temperature as space where they are to be installed.
  - 1. Move floor coverings and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- D. Sweep and vacuum clean substrates to be covered by floor coverings immediately before installation.

### **3.3 INSTALLATION, GENERAL**

- A. Install static-control resilient floor covering according to manufacturer's written instructions.
- B. Embed grounding strips in static-control adhesive. Extend grounding strips beyond perimeter of static-control resilient floor covering surfaces to ground connections.
- C. Scribe, cut, and fit floor coverings to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- D. Extend floor coverings into toe spaces, door reveals, closets, and similar openings. Extend floor covering to center of door openings.
- E. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor coverings as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.
- F. Adhere floor coverings to substrates using a full spread of static-control adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

### **3.4 FLOOR TILE INSTALLATION**

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so floor tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half floor tile at perimeter.
  - 1. Lay floor tiles square with room axis.
- C. Match floor tiles for color and pattern by selecting floor tiles from cartons in same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed floor tiles.

### **3.5 FIELD QUALITY CONTROL**

- A. Testing: Engage a qualified testing agency to test electrical resistance of static-control resilient floor covering systems for compliance with requirements.
  - 1. Arrange for testing after installation static-control adhesives have fully cured and floor covering systems have stabilized to ambient conditions and after ground connections are completed.
- B. Static-control resilient floor coverings will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

**3.6 CLEANING AND PROTECTION**

- A. Comply with manufacturer's written instructions for cleaning and protection of floor coverings.
- B. Perform the following operations immediately after completing floor covering installation:
  - 1. Remove static-control adhesive and other blemishes from exposed surfaces.
  - 2. Sweep and vacuum surfaces thoroughly.
  - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect floor coverings from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
  - 1. Do not wax static-control resilient floor coverings.
- D. Cover floor coverings until Substantial Completion.

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**SECTION 09 67 23**

**RESINOUS FLOORING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies a seamless flooring system with integral base.
- B. Flooring consists of urethane resin (flooring), epoxy resin (coved base), aggregate, and finish coats for non-slip finish.

**1.2 RELATED WORK**

- A. Color and room finish schedule: Section 09 06 00, SCHEDULE FOR FINISHES.

**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. Description of product to be provided; technical data showing compliance with specifications.
  - 2. Application and installation instructions, including proposed deviations from specifications.
- C. Samples:
  - 1. Each color specified in Section 09 06 00, SCHEDULE FOR FINISHES.
  - 2. Sample 300 mm (12-inch) square in each finish specified.
  - 3. Sample showing construction from substrate to finish surface in thickness specified.
- D. Certification and Approval:
  - 1. Manufacturer's certification of material compliance.
  - 2. Manufacturer's approval of installers.
  - 3. Contractor's certificate of compliance with Quality Assurance requirements.
- E. Warranty: Manufacturers warranty of materials and installation.

**1.4 QUALITY ASSURANCE**

- A. Single Source Responsibility:
  - 1. Obtain primary resinous flooring materials including primers, resins, hardening agents, finish or sealing coats from a single manufacturer.

2. Provide secondary materials only of type and from source recommended by manufacturer of primary materials.
- B. Installer trained and approved by manufacturer of primary material and having completed at least five projects of similar size and complexity.
- C. Pre-Installation Conference
  1. Arrange a meeting not less than thirty days prior to starting work.
  2. Attendance
    - a. Contractor
    - b. Resident Engineer
    - c. Manufacturer and Installer's Representative

#### **1.5 MATERIAL PACKAGING DELIVERY AND STORAGE**

- 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. Protect materials from damage and contamination in storage.
- C. Maintain temperature of storage area between 15° C and 32° C (60° F and 90° F).
- D. Package materials in factory pre-weighed and in single, easy to manage batches sized for ease of handling and mixing proportions from entire package or packages.

#### **1.6 WARRANTY**

- A. Work subject to the terms of the Article "Warranty of Construction" FAR clause 52.246-21.
- B. Extend warranty period to three years.

#### **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):
  1. B221-06 Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
  2. C267-01 (R2006) Chemical Resistance of Mortars, Grouts, and Monolithic Surfacing
  3. C413-01 (R2006) Absorption of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacing, and Polymer Concretes

4. C580-02 Flexural Strength and Modulus of Elasticity of Chemical Resistant Mortars, Grouts, Monolithic Surfacing and Polymer Concretes
  5. C722-04 Chemical-Resistant Resin Monolithic Surfacing
  6. C811-98 (R2003) Surface Preparation of Concrete for Application of Chemical-Resistant Resin Monolithic Surfacing
  7. C882-05 Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear
  8. D2047-04 Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine
- C. National Association of Architectural Metal Manufacturers (NAAMM):
1. AMP 501 Finishes for Aluminum

## PART 2 - PRODUCTS

### 2.1 SYSTEM DESCRIPTION

- A. Nominal 3/16" (5mm) thick system comprised of a three component mortar consisting of pigmented urethane resin, curing agent, and rubber aggregates, and grouted with a two-component, 100% aliphatic urethane groutcoat and a two-component, water-based, flat, aliphatic polyurethane topcoat.
- B. Troweled epoxy mortar, coved base aggregates, amine curing agent, and soy based additives.

### 2.2 RESINOUS FLOORING SYSTEM

- A. Physical Properties of flooring system addition to C722 when tested as follows:

Property	Test	Value
Hardness	ASTM D2240 Shore Durometer	75-80
Bond	ASTM C882 Bonding epoxy flooring to hardened concrete	min 400 psi
Water Absorption	ASTM C413	max 0.1 percent
Abrasion Resistance	ASTM D4060 Taber Abrader CS-17 wheel, 1000 gm load; 1000 cycle	max 0.10 gms. weight loss
Flexural Strength	ASTM C580	min 2200 psi

Property	Test	Value
Extent of Burning extinguishing Heat Resistant	ASTM D635	max 0.25 inch self
	For continuous exposure min 140 deg. F	No Effect
	For intermittent spills min 200 deg. F	No Effect
Coefficient of Friction	ASTM D 2047	0.7
Chemical Resistance of the following:	ASTM C267	No Effect
Acetic acid	5 percent	
Ammonium hydroxide	10 percent	
Citric Acid	50 percent	
Fatty acid Motor Oil, 20W		
Hydrochloric acid	10 percent	
Salt water	10 percent	
Sodium Hydroxide	10 percent	
Sulfuric acid	10 percent	
Trisodium phosphate	5 percent	
Urine		
Feces		
Hydrogen peroxide	28 percent	
Distilled Water		
Sodium Hypochloride	5.28 percent	

- B. Primer, Coloring, Sealer, and Finish coats as standard with manufacture of flooring system.

### 2.3 BASE CAP STRIP

- A. Aluminum, Extruded: ASTM B221, Alloy 6063-T6.
- B. Shape for 5 mm (3/16 inch) depth of base material, "J" configuration.
- C. Finish:
1. Finish exposed surfaces in accordance with NAAMM Metal Finishes Manual.
  2. Aluminum: NAAMM Amp 501:
    - a. Clear anodic coating, AA-C22A41 chemically etched medium matte, with Architectural Class 1, 0.7 mils or thicker.



### **PART 3 - EXECUTION**

#### **3.1 PROJECT CONDITIONS**

- A. Maintain temperature of materials above 21° C (70° F), for 48 hours before installation.
- B. Maintain temperature of rooms where work occurs, between 21° C and 32° C (70° F and 90° F) for at least 48 hours, before, during, and 24 hours after installation. Maintain temperature at least 21° C (70° F) thereafter.
- C. Do not install materials until building is permanently enclosed and wet construction is complete, dry, and cured.
- D. Concrete substrate cured and not less than 30 days old.
- E. Area free of other trades during and for a period of 24 hours after installation.

#### **3.2 INSTALLATION REQUIREMENTS**

- A. The respective manufacturer's instructions for application and installation will be considered for use when approved by the Resident Engineer.
- B. Submit proposed installation deviation from this specification to the Resident Engineer indicating the differences in the method of installation.

#### **3.3 PREPARATION**

- A. Prepare surface in accordance with ASTM C811 except where specific manufacturers instructions supersede.
- B. Mechanically remove bond inhibiting materials and loose or laitance materials to ensure bond.
- C. Prepare wall and set base cap mold level.
  - 1. Fill voids within the height of the wall where base is applied even with the wall surface.
  - 2. Grind, sand, or cut away protrusions.

#### **3.4 APPLICATION**

- A. Mix and apply each component of resinous flooring system in compliance with manufacturer's specifications to produce a uniform monolithic flooring surface of 5 mm (3/16 inch) minimum thickness.
- B. Turn flooring up for coved 100 mm (4-inch) high base at vertical wall surfaces and penetrations. Cove joint with floor; 6 mm (1/4 inch) radius. Round interior and external corners.
- C. Apply primer over prepared substrate at manufacturers specified rate. Coordinate timing of primer application with application of troweled mortar

to ensure optimum adhesion between resinous flooring materials and substrate.

- D. Uniformly spread mortar over substrate adjusted to manufacturer's recommended maximum thickness to plane line of floor.
- E. Trowel finish for smooth surface on base and coved surface.
- F. Grout mortar surface as specified by manufacturer and broadcast colored quartz aggregate uniformly distributed for non-slip texture on floors to within one inch of base cove horizontal edge.
- G. Apply a clear finish coat.

### 3.5 CURING, PROTECTION AND CLEANING

- A. Cure resinous flooring materials in compliance with manufacturer's directions, taking care to prevent contamination during stages of application and prior to completion of curing process.
- B. Close area of application for a minimum of 24 hours.
- C. Protect resinous flooring materials from damage and wear during construction operation.
  - 1. Cover flooring with kraft paper.
  - 2. Cover paper with 6 mm (1/4 inch) thick hardboard, plywood, or particle board where area is in foot or vehicle traffic pattern, rolling or fixed scaffolding and overhead work occurs.
- D. Remove temporary covering and clean resinous flooring just prior to final inspection. Use cleaning materials and procedures recommended by resinous flooring manufacturer.

### 3.6 TOLERANCE

- A. From line of plane: Maximum 3 mm (1/8 inch) in total distance of flooring and base.
- B. From radius of cove: Maximum of 3 mm (1/8 inch) plus or 1.6 mm (1/16-inch) minus.

- - - E N D - - -

**SECTION 09 91 00**

**PAINTING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Section specifies field painting.
- B. Section specifies prime coats which may be applied in shop under other sections.
- C. Painting includes shellacs, stains, varnishes, coatings specified, and striping or markers and identity markings.

**1.2 RELATED WORK**

- A. Shop prime painting of steel and ferrous metals: Division 05 - METALS, Division 08 - OPENINGS, Division 10 - SPECIALTIES, Division 11 - EQUIPMENT, Division 12 - FURNISHINGS, Division 13 - SPECIAL CONSTRUCTION, Division 14 - CONVEYING EQUIPMENT, Division 21 - FIRE SUPPRESSION, Division 22 - PLUMBING, Division 23 - HEATING, VENTILATION AND AIR-CONDITIONING, Division 26 - ELECTRICAL, Division 27 - COMMUNICATIONS, and Division 28 - ELECTRONIC SAFETY AND SECURITY sections.
- B. Type of Finish, Color, and Gloss Level of Finish Coat: Section 09 06 00, SCHEDULE FOR FINISHES.
- C. Asphalt and concrete pavement marking: Section 32 17 23, PAVEMENT MARKINGS.

**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. Before work is started, or sample panels are prepared, submit manufacturer's literature, 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 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.
- C. 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 by 250 by 3 mm (4 inch by 10 inch by 1/8 inch).
  3. Panel to show transparent finishes: Wood of same species and grain pattern as wood approved for use, 100 by 250 by 3 mm (4 inch by 10 inch face by 1/4 inch) thick minimum, and where both flat and edge grain will be exposed, 250 mm (10 inches) long by sufficient size, 50 by 50 mm (2 by 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 Section 09 06 00, SCHEDULE FOR FINISHES.
    - 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.
- D. Sample of identity markers if used.
- E. Manufacturers' Certificates indicating compliance with specified requirements:
1. Manufacturer's paint substituted for Federal Specification paints meets or exceeds performance of paint specified.
  2. High temperature aluminum paint.
  3. Epoxy coating.
  4. Intumescent clear coating or fire retardant paint.

#### 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. If paint or other coating, state coat types; prime, body or finish.

- C. Maintain space for storage, and handling of painting materials and equipment in a 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 18 and 30 degrees C (65 and 85 degrees F).

#### 1.5 **MOCK-UP PANEL**

- A. Before starting application of water paint mixtures,, apply paint as specified to an area, not to exceed 9 m<sup>2</sup> (100 ft<sup>2</sup>), selected by Resident Engineer.
- B. Finish and texture approved by Resident Engineer will be used as a standard of quality for remainder of work.

#### 1.6 **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):
  - 1. ACGIH TLV-BKLT-2008 Threshold Limit Values (TLV) for Chemical Substances and Physical Agents and Biological Exposure Indices (BEIs)
  - 2. ACGIH TLV-DOC-2008 Documentation of Threshold Limit Values and Biological Exposure Indices, (Seventh Edition)
- C. American National Standards Institute (ANSI):
  - 1. A13.1-96 Scheme for the Identification of Piping Systems
- D. American Society for Testing and Materials (ASTM):
  - 1. D260-86 Boiled Linseed Oil
- E. Commercial Item Description (CID):
  - 1. A-A-1555 Water Paint, Powder (Cementitious, White and Colors) (WPC) (cancelled)
  - 2. A-A-3120 Paint, For Swimming Pools (RF) (cancelled)
- F. Master Painters Institute (MPI):
  - 1. 22-07 Aluminum Paint, High Heat (up to 590° - 1100F) (HR)
  - 2. 36-07 Knot Sealer
  - 3. 39-07 Interior Latex Wood Primer
  - 4. 50-07 Interior Latex Primer Sealer
  - 5. 67-07 Interior Latex Fire Retardant, Top-Coat (ULC Approved) (FR)
  - 6. 90-07 Interior Wood Stain, Semi-Transparent (WS)

7. 91-07 Wood Filler Paste
8. 99-07 Sealer, Water Based, for Concrete Floors
9. 101-07 Epoxy Anti-Corrosive Metal Primer
10. 108-07 High Build Epoxy Coating, Low Gloss (EC)
11. 134-07 Waterborne Galvanized Primer
12. 139-07 Interior High Performance Latex, MPI Gloss Level 3 (LL)
13. 143-10 Interior Latex, Institutional Low Odor/VOC, MPI Gloss Level 1 (LE)
14. 145-10 Interior Latex, Institutional Low Odor/VOC, MPI Gloss Level 3 (LE)
15. 149-07 Interior Latex Primer Sealer, Institutional Low Odor/VOC
16. 153-07 Light Industrial Coating, Interior, Water Based, Semi-Gloss (MPI Gloss level 5)
17. 163-07 Light Industrial Coating, Exterior, Water Based, Semi-Gloss (MPI Gloss Level 5)

G. Steel Structures Painting Council (SSPC):

1. SSPC SP 1-04 (R2004) Solvent Cleaning
2. SSPC SP 2-04 (R2004) Hand Tool Cleaning
3. SSPC SP 3-04 (R2004) Power Tool Cleaning

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. Interior/Exterior Latex Block Filler: MPI 4.
- B. Exterior Latex Wood Primer: MPI 6.
- C. Exterior Latex, Semi-Gloss (AE): MPI 11, professional quality (100% acrylic) formulation.
- D. Organic Zinc rich Coating (HR): MPI 18.
- E. High Heat Resistant Coating (HR): MPI 22.
- F. Knot Sealer: MPI 36.
- G. Interior Latex Wood Primer: MPI 39.
- H. Interior Latex Fire Retardant, Top-Coat (ULC Approved) (FR): MPI 67.
- I. Marine Alkyd Metal primer: MPI 79.
- J. Interior Wood Stain, Semi-Transparent (WS): MPI 90.

- K. Wood Filler Paste: MPI 91.
- L. Exterior Alkyd, Semi-Gloss (EO): MPI 94.
- M. High Build Epoxy Coating: MPI 98.
- N. Rust Inhibitive Primer, Water Based: MPI 107, acrylic direct to metal (DTM) primer.
- O. High Build Epoxy Marine Coating (EC): MPI 108.
- P. Waterborne Galvanized Primer: MPI 134.
- Q. Interior High Performance Latex, MPI Gloss Level 3 (LL): MPI 139.
- R. Interior High Performance Latex (SG), MPI Gloss Level 5: MPI 141.
- S. Interior Latex, Institutional Low Odor/VOC, MPI Gloss Level 1 (LE): MPI 143.
- T. Interior Latex, Institutional Low Odor/VOC, MPI Gloss Level 3 (LE): MPI 145.
- U. Interior Latex, Institutional Low Odor/VOC, MPI Gloss Level 5 (LE): MPI 147.
- V. Interior Latex Primer Sealer, Institutional Low Odor/VOC: MPI 149

## **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.

## **2.3 REGULATORY REQUIREMENTS/QUALITY ASSURANCE**

- A. VOC Content: Products shall comply with VOC limits of Bay Area Air Quality Management District (BAAQMD), Reg. 8, Rule 3, effective 01/01/2004.
  - 1. Flat Paints, Coatings, and Primers: 100 g/L.
  - 2. Nonflat Paints, Coatings, and Primers: 150 g/L.
  - 3. Nonflat (High Gloss) Paints, Coatings, and Primers: 250 g/L.
  - 4. Primers, Sealers, and Undercoaters: 200 g/L.
  - 5. Anticorrosive and Anti-Rust Paints Applied to Ferrous Metals: 400 g/L.
  - 6. Clear Wood Finishes, Lacquers: 550 g/L.
  - 7. Clear Wood Finishes, Varnishes: 350 g/L.

8. Dry-Fog Coatings: 400 g/L.
  9. Floor Coatings: 250 g/L.
  10. High Temperature Industrial Maintenance Coatings: 420 g/L.
  11. Industrial Maintenance Coatings: 250 g/L.
  12. Pretreatment Wash Primers: 420 g/L.
  13. Shellacs, Clear: 730 g/L.
  14. Shellacs, Pigmented: 550 g/L.
  15. Zinc-Rich Industrial Maintenance Primers: 250 g/L.
- B. Lead-Base Paint:
1. 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.
  2. 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. Asbestos: Materials shall not contain asbestos.
- D. Chromate, Cadmium, Mercury, and Silica: Materials shall not contain zinc-chromate, strontium-chromate, Cadmium, mercury or mercury compounds or free crystalline silica.
- E. Human Carcinogens: Materials shall not contain any of the ACGIH-BKLT and ACGHI-DOC confirmed or suspected human carcinogens.
- F. Use high performance acrylic paints in place of alkyd paints, where possible.
- G. VOC content for solvent-based paints shall not exceed 250g/l and shall not be formulated with more than one percent aromatic hydro carbons by weight.

### **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 days 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 Contracting Officer and the product manufacturer. Under no circumstances shall application conditions exceed manufacturer recommendations.
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 soon 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 where allowed by manufacturer's printed instructions.
  - b. Dampened with a fine mist of water on hot dry days concrete and masonry surfaces to which water thinned acrylic and cementitious paints are applied to prevent excessive suction and to cool surface.
6. Varnishing:
  - a. Apply in clean areas and in still air.
  - b. Before varnishing vacuum and dust area.
  - c. Immediately before varnishing wipe down surfaces with a tack rag.

### 3.2 SURFACE PREPARATION

- A. Method of surface preparation is optional, provided results of finish painting produce solid even color and texture specified with no overlays.
- B. General:
  1. Remove prefinished items not to be painted such as lighting fixtures, escutcheon plates, hardware, trim, and similar items for reinstallation after paint is dried.
  2. Remove items for reinstallation and complete painting of such items and adjacent areas when item or adjacent surface is not accessible or finish is different.
  3. See other sections of specifications for specified surface conditions and prime coat.
  4. Clean surfaces for painting 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.
- C. 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. Surface painted with an opaque finish:
    - a. Coat knots, sap and pitch streaks with MPI 36 (Knot Sealer) before applying paint.
    - b. Apply two coats of MPI 36 (Knot Sealer) over large knots.
  5. 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.
  6. Before applying finish coat, reapply wood filler paste if required, and sand surface to remove surface blemishes. Finish flush with adjacent surfaces.
  7. 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.
- D. 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). Exception: where high temperature aluminum paint is used, prepare surface in accordance with paint manufacturer's instructions.
  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. This includes 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.
- E. 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) or MPI 135 (Non- Cementitious Galvanized Primer) depending on finish coat compatibility.

F. Concrete:

1. Clean and remove dust, dirt, oil, grease efflorescence, form release agents, laitance, and other deterrents to paint adhesion.
2. Use emulsion type cleaning agents to remove oil, grease, paint and similar products. Use of solvents, acid, or steam is not permitted.
3. Neutralize Concrete floors to be painted by washing with a solution of 1.4 Kg (3 pounds) of zinc sulfate crystals to 3.8 L (1 gallon) of water, allow to dry three days and brush thoroughly free of crystals.
4. Repair broken and spalled concrete edges with concrete patching compound to match adjacent surfaces as specified in CONCRETE Sections. Remove projections to level of adjacent surface by grinding or similar methods.

G. 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 Gypsum (Spackling Compound) 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.

### 3.3 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 component and two 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.

### 3.4 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 coats; prime, body, and finish. When two 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 Resident Engineer.
- E. Finish surfaces to show solid even color, free from runs, lumps, brushmarks, laps, holidays, or other defects.
- F. Apply by brush, roller or spray, except as otherwise specified.
- G. Do not spray paint in existing occupied spaces unless approved by Resident Engineer, except in spaces sealed from existing occupied spaces.
  - 1. Apply painting materials specifically required by manufacturer to be applied by spraying.
  - 2. In areas, 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 WORK NOT PAINTED, motors, controls, telephone, and electrical equipment, fronts of sterilizes and other recessed equipment and similar prefinished items.
- H. 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.

### 3.5 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 rebates for stop and face glazing of wood, and for face glazing of steel.
- E. Wood and Wood Particleboard:
  - 1. Use same kind of primer specified for exposed face surface.
    - a. Exterior wood: except where MPI 90 (Interior Wood Stain, Semi-Transparent (WS) is scheduled.
    - b. Interior wood except for transparent finish: MPI 39 (Interior Latex Wood Primer), thinned if recommended by manufacturer.

- c. Transparent finishes as specified under Transparent Finishes on Wood except Floors.
  2. Apply two coats of primer MPI 6 (Exterior Latex Wood Primer) or MPI 39 (Interior Latex Wood Primer) to surfaces of wood doors, including top and bottom edges, which are cut for fitting or for other reason.
  3. Apply one coat of primer MPI 6 (Exterior Latex Wood Primer) or MPI 39 (Interior Latex Wood Primer) as soon as delivered to site to surfaces of unfinished woodwork, except concealed surfaces of shop fabricated or assembled millwork and surfaces specified to have varnish, stain or natural finish.
  4. Back prime and seal ends of exterior woodwork, and edges of exterior plywood specified to be finished.
  5. Apply MPI 67 (Interior Latex Fire Retardant, Top-Coat (ULC Approved) (FR)) to wood for fire retardant finish.
- F. Metals except boilers, incinerator stacks, and engine exhaust pipes:
1. Steel and iron: MPI 107 (Rust Inhibitive Primer, water based)
  2. Zinc-coated steel and iron: MPI 134 (Waterborne Galvanized Primer).
  3. Asphalt coated metal: MPI 1 (Aluminum Paint (AP)).
  4. Metal over 94 degrees C. (200 degrees F), Boilers, Incinerator Stacks, and Engine Exhaust Pipes: MPI 22 (High Heat Resistant Coating (HR)).
- G. Gypsum Board:
1. Surfaces scheduled to have MPI 11 (Exterior Latex, Latex, Semi-Gloss (AE)) MPI 139 Interior High Performance Latex, Gloss Level 3 (LL) MPI 141 Interior High Performance Latex, Gloss Level 5 (SG) MPI 143 (Interior Latex, Institutional Low Odor/VOC, Gloss Level 1 (LE) MPI 145 (Interior Latex, Institutional Low Odor/VOC, Gloss Level 3 (LE) MPI 147 (Interior Latex, Institutional Low Odor/VOC, Gloss Level 5 (LE) finish: Use MPI 11 (Exterior Latex, Semi-Gloss (AE)) MPI 139 Interior High Performance Latex, Gloss Level 3 (LL) MPI 141 Interior High Performance Latex, Gloss Level 5 (SG) MPI 143 (Interior Latex, Institutional Low Odor/VOC, Gloss Level 1 (LE) MPI 145 (Interior Latex, Institutional Low Odor/VOC, Gloss Level 3 (LE) MPI 147 (Interior Latex, Institutional Low Odor/VOC, Gloss Level 5 (LE) respectively.
  2. Primer: MPI 149 (Interior Latex Primer Sealer, Institutional Low Odor/VOC) in shower and bathrooms.
  3. Surfaces scheduled to receive vinyl coated fabric wallcovering: Use MPI 50 (Interior Latex Primer Sealer).
  4. Use MPI 101 (Cold Curing Epoxy Primer) for surfaces scheduled to receive MPI 98 (High Build Epoxy Coating) MPI 108 (High Build Epoxy Marine Coating (EC)) finish.

### 3.6 EXTERIOR FINISHES

- A. Apply following finish coats where specified in Section 09 06 00, SCHEDULE FOR FINISHES.

B. Wood:

1. Do not apply finish coats on surfaces concealed after installation, top and bottom edges of wood doors and sash, or on edges of wood framed insect screens.
2. Portion of sash runs of double hung wood windows, concealed by sash when in a closed position: Apply two coats of ASTM D260 mixed with not more than 0.12L (1/4 pint) of dryer per 3.89L (gallon).
3. Two coats of MPI 11 (Exterior Latex, Semi- Gloss on exposed surfaces, except where transparent finish is specified.
4. Two coats offor transparent finish.

C. Steel and Ferrous Metal:

- a. Two coats of MPI 94 (Exterior Alkyd, Semi-Gloss (EO)) on exposed surfaces, except on surfaces over 94 degrees C (200 degrees F).
- b. One coat of MPI 22 (High Heat Resistant Coating (HR)) on surfaces over 94 degrees K (200 degrees F).

D. Machinery without factory finish except for primer: One coat MPI 94 (Exterior Alkyd, Semi-Gloss (EO)) .

E. Concrete :

- a. Where specified in Section 09 06 00, SCHEDULE FOR FINISHES or shown.
  - b. Mix as specified in manufacturer's printed directions.
  - c. Do not mix more paint at one time than can be used within four hours after mixing. Discard paint that has started to set.
  - d. Dampen warm surfaces above 24 degrees C (75 degrees F) with fine mist of water before application of paint. Do not leave free water on surface.
  - e. Cure paint with a fine mist of water as specified in manufacturer's printed instructions.
2. Use two coats of TT-P-1411 (Paint, Co-polymer-Resin, Cementitious (CEP)), unless specified otherwise.

### 3.7 INTERIOR FINISHES

A. Apply following finish coats over prime coats in spaces or on surfaces specified in Section 09 06 00, SCHEDULE FOR FINISHES.

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. One coat of MPI 46 (Interior Enamel Undercoat) plus one coat of MPI 47 (Interior Alkyd, Semi-Gloss (AK)) on exposed interior surfaces of alkyd-amine enamel prime finished windows.
  - b. Machinery: One coat MPI 9 (Exterior Alkyd Enamel (EO)).

- c. Asphalt Coated Metal: One coat MPI 1 (Aluminum Paint (AP)).
  - d. Ferrous Metal over 94 degrees K (200 degrees F): Boilers, Incinerator Stacks, and Engine Exhaust Pipes: One coat MPI 22 (High Heat Resistant Coating (HR)).
- C. Gypsum Board:
1. One coat of MPI 50 (Interior Primer Sealer, Latex) plus one coat of MPI 143 (Interior Institutional Low Odor/VOC, Flat (LE)).
  2. One coat of MPI 50 (Interior Primer Sealer, Latex) plus one coat of MPI 145 (Interior Institutional Low Odor/VOC, Eggshell (LE)).
  3. One coat of MPI 50 (Interior Primer Sealer, Latex) plus one coat of MPI 147 (Interior Institutional Low Odor/VOC, Semi-Gloss (LE)).
- 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. Sealers:
    - a. Apply sealers specified except sealer may be omitted where pigmented, penetrating, or wiping stains containing resins are used.
    - b. Allow manufacturer's recommended drying time before sanding, but not less than 24 hours or 36 hours in damp or muggy weather.
    - c. Sand as specified.
  3. Paint Finish:
    - a. One coat of MPI 39 (Interior Latex Wood Primer) plus one coat of MPI 143 (Interior Institutional Low Odor/VOC, Flat (LE)).
    - b. One coat of MPI 39 (Interior Latex Wood Primer) plus one coat of MPI 145 (Interior Institutional Low Odor/VOC, Eggshell (LE)).
    - c. One coat of MPI 39 (Interior Latex Wood Primer) plus one coat of MPI 147 (Interior Institutional Low Odor/VOC, Semi-Gloss (LE)).
  4. Transparent Finishes on Wood Except Floors.
    - a. Natural Finish:
      - 1) One coat of sealer.
      - 2) Two coats of MPI 71 (Polyurethane, Moisture Cured, Clear Flat (PV)) MPI 31 (Polyurethane, Moisture Cured, Clear Gloss (PV)).
    - b. Stain Finish:
      - 1) One coat of MPI 90 (Interior Wood Stain, Semi-Transparent (WS)).
      - 2) Use wood stain of type and color required to achieve finish specified. Do not use varnish type stains.
      - 3) One coat of sealer.

- 4) Two coats of.
- c. Varnish Finish:
  - 1) One coat of sealer.
  - 2) Two coats of MPI 31 (Polyurethane Moisture Cured, Clear Gloss (PV)).

### 3.8 PAINT COLOR

- A. Color and gloss of finish coats is specified in Section 09 06 00, SCHEDULE FOR FINISHES.
- B. For additional requirements regarding color see Articles, REFINISHING EXISTING PAINTED SURFACE and MECHANICAL AND ELECTRICAL FIELD PAINTING iii
- C. 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.
- D. 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.

### 3.9 MECHANICAL AND ELECTRICAL WORK FIELD PAINTING SCHEDULE

- A. Field painting of mechanical and electrical consists of cleaning, touching-up abraded shop prime coats, and applying prime, body and finish coats to materials and equipment if not factory finished in space scheduled to be finished.
- B. In spaces not scheduled to be finish painted in Section 09 06 00, SCHEDULE FOR FINISHES paint as specified under paragraph H, colors.
- C. Paint various systems specified in Division 02 - EXISTING CONDITIONS, Division 21 - FIRE SUPPRESSION, Division 22 - PLUMBING, Division 23 - HEATING, VENTILATION AND AIR-CONDITIONING, Division 26 - ELECTRICAL, Division 27 - COMMUNICATIONS, and Division 28 - ELECTRONIC SAFETY AND SECURITY.
- D. Paint after tests have been completed.
- E. Omit prime coat from factory prime-coated items.
- F. Finish painting of mechanical and electrical equipment is not required when located in interstitial spaces, above suspended ceilings, in concealed areas such as pipe and electric closets, pipe basements, pipe tunnels, trenches, attics, roof spaces, shafts and furred spaces except on electrical conduit containing feeders 600 volts or more.



- G. Omit field painting of items specified in paragraph, Building and Structural WORK NOT PAINTED.
- H. Color:
1. Paint items having no color specified in Section 09 06 00, SCHEDULE FOR FINISHES to match surrounding surfaces.
  2. Paint colors as specified in Section 09 06 00, SCHEDULE FOR FINISHES except for following:
    - a. White: Exterior unfinished surfaces of enameled plumbing fixtures. Insulation coverings on breeching and uptake inside boiler house, drums and drum-heads, oil heaters, condensate tanks and condensate piping.
    - b. Gray: Heating, ventilating, air conditioning and refrigeration equipment (except as required to match surrounding surfaces), and water and sewage treatment equipment and sewage ejection equipment.
    - c. Aluminum Color: Ferrous metal on outside of boilers and in connection with boiler settings including supporting doors and door frames and fuel oil burning equipment, and steam generation system (bare piping, fittings, hangers, supports, valves, traps and miscellaneous iron work in contact with pipe).
    - d. Federal Safety Red: Exposed fire protection piping hydrants, post indicators, electrical conducts containing fire alarm control wiring, and fire alarm equipment.
    - e. Federal Safety Orange: Entire lengths of electrical conduits containing feeders 600 volts or more.
    - f. Color to match brickwork sheet metal covering on breeching outside of exterior wall of boiler house.
- I. Apply paint systems on properly prepared and primed surface as follows:
1. Exterior Locations:
    - a. Apply two coats of MPI 163 (Direct to Metal, Light Industrial Coating, Exterior, Semi-Gloss) to the following ferrous metal items: Vent and exhaust pipes with temperatures under 94 degrees C (200 degrees F), roof drains, fire hydrants, post indicators, yard hydrants, exposed piping and similar items.
    - b. Apply two coats of MPI 163 (Direct to Metal, Light Industrial Coating, Exterior, Semi-Gloss) to the following metal items: Galvanized and zinc-copper alloy metal.
    - c. Apply one coat of MPI 22 (High Heat Resistant Coating (HR)), 650 degrees C (1200 degrees F) to incinerator stacks, boiler stacks, and engine generator exhaust.
  2. Interior Locations:
    - a. Apply two coats of MPI 153 (Direct to Metal, Light Industrial Coating, Interior, Water Based, Semi-Gloss) to following items:
      - 1) Metal under 94 degrees C (200 degrees F) of items such as bare piping, fittings, hangers and supports.
      - 2) Equipment and systems such as hinged covers and frames for control cabinets and boxes, cast-iron radiators, electric conduits and panel boards.

- 3) Heating, ventilating, air conditioning, plumbing equipment, and machinery having shop prime coat and not factory finished.
  - b. Ferrous metal exposed in hydrotherapy equipment room and chlorinator room of water and sewerage treatment plants: One coat of MPI 101 (Cold Curing Epoxy Primer) and one coat of MPI 108 (High Build Epoxy Marine coating (EC)).
  - c. Apply one coat of MPI 50 (Interior Latex Primer Sealer) and one coat of on finish of insulation on boiler breeching and uptakes inside boiler house, drums, drumheads, oil heaters, feed water heaters, tanks and piping.
  - d. Apply two coats of MPI 22 (High Heat Resistant Coating (HR)) to ferrous metal surface over 94 degrees K (200 degrees F) of following items:
    - 1) Garbage and trash incinerator.
    - 2) Medical waste incinerator.
    - 3) Exterior of boilers and ferrous metal in connection with boiler settings including supporting members, doors and door frames and fuel oil burning equipment.
    - 4) Steam line flanges, bare pipe, fittings, valves, hangers and supports over 94 degrees K (200 degrees F).
    - 5) Engine generator exhaust piping and muffler.
  - e. Paint electrical conduits containing cables rated 600 volts or more using two coats of MPI 94 (Exterior Alkyd, Semi-gloss (EO) in the Federal Safety Orange color in exposed and concealed spaces full length of conduit.
3. Other exposed locations:
- a. Metal surfaces, except aluminum, of cooling towers exposed to view, including connected pipes, rails, and ladders: Two coats of MPI 1 (Aluminum Paint (AP)).
  - b. Cloth jackets of insulation of ducts and pipes in connection with plumbing, air conditioning, ventilating refrigeration and heating systems: One coat of MPI 50 (Interior Latex Primer Sealer) and one coat of MPI 11 (Exterior Latex Semi-Gloss (AE)).

### **3.10 BUILDING AND STRUCTURAL WORK FIELD PAINTING**

- A. Painting and finishing of interior and exterior work except as specified under paragraph 3.11 B.
1. Painting and finishing of new work including colors and gloss of finish selected is specified in Finish Schedule, Section 09 06 00, SCHEDULE FOR FINISHES.
  2. Painting of disturbed, damaged and repaired or patched surfaces when entire space is not scheduled for complete repainting or refinishing.
  3. Painting of ferrous metal and galvanized metal.
  4. Painting of wood with fire retardant paint exposed in attics, when used as mechanical equipment space except shingles.
  5. Identity painting and safety painting.

- B. Building and Structural Work not Painted:
1. Prefinished items:
    - a. Casework, doors, elevator entrances and cabs, metal panels, wall covering, and similar items specified factory finished under other sections.
    - b. Factory finished equipment and pre-engineered metal building components such as metal roof and wall panels.
  2. Finished surfaces:
    - a. Hardware except ferrous metal.
    - b. Anodized aluminum, stainless steel, chromium plating, copper, and brass, except as otherwise specified.
    - c. Signs, fixtures, and other similar items integrally finished.
  3. Concealed surfaces:
    - a. Inside dumbwaiter, elevator and duct shafts, interstitial spaces, pipe basements, crawl spaces, pipe tunnels, above ceilings, attics, except as otherwise specified.
    - b. Inside walls or other spaces behind access doors or panels.
    - c. Surfaces concealed behind permanently installed casework and equipment.
  4. Moving and operating parts:
    - a. Shafts, chains, gears, mechanical and electrical operators, linkages, and sprinkler heads, and sensing devices.
    - b. Tracks for overhead or coiling doors, shutters, and grilles.
  5. Labels:
    - a. Code required label, such as Underwriters Laboratories Inc., Inchcape Testing Services, Inc., or Factory Mutual Research Corporation.
    - b. Identification plates, instruction plates, performance rating, and nomenclature.
  6. Galvanized metal:
    - a. Exterior chain link fence and gates, corrugated metal areaways, and gratings.
    - b. Gas Storage Racks.
    - c. Except where specifically specified to be painted.
  7. Metal safety treads and nosings.
  8. Gaskets.
  9. Concrete curbs, gutters, pavements, retaining walls, exterior exposed foundation walls and interior walls in pipe basements.
  10. Face brick.
  11. Structural steel encased in concrete, masonry, or other enclosure.
  12. Structural steel to receive sprayed-on fire proofing.
  13. Ceilings, walls, columns in interstitial spaces.
  14. Ceilings, walls, and columns in pipe basements.

15. Wood Shingles.

**3.11 IDENTITY PAINTING SCHEDULE**

A. Identify designated service in accordance with ANSI A13.1, unless specified otherwise, on exposed piping, piping above removable ceilings, piping in accessible pipe spaces, interstitial spaces, and piping behind access panels.

1. Legend may be identified using 2.1 G options or by stencil applications.
2. Apply legends adjacent to changes in direction, on branches, where pipes pass through walls or floors, adjacent to operating accessories such as valves, regulators, strainers and cleanouts a minimum of 12000 mm (40 feet) apart on straight runs of piping. Identification next to plumbing fixtures is not required.
3. Locate Legends clearly visible from operating position.
4. Use arrow to indicate direction of flow.
5. Identify pipe contents with sufficient additional details such as temperature, pressure, and contents to identify possible hazard. Insert working pressure shown on drawings where asterisk appears for High, Medium, and Low Pressure designations as follows:
  - a. High Pressure - 414 kPa (60 psig) and above.
  - b. Medium Pressure - 104 to 413 kPa (15 to 59 psig).
  - c. Low Pressure - 103 kPa (14 psig) and below.
  - d. Add Fuel oil grade numbers.
6. Legend name in full or in abbreviated form as follows:

PIPING	COLOR OF EXPOSED PIPING	COLOR OF BACK-GROUND	COLOR OF LETTERS	LEGEND ABBREVIATIONS
Blow-off		Yellow	Black	Blow-off
Boiler Feedwater		Yellow	Black	Blr Feed
A/C Condenser Water Supply		Green	White	A/C Cond Wtr Sup
A/C Condenser Water Return		Green	White	A/C Cond Wtr Ret
Chilled Water Supply		Green	White	Ch. Wtr Sup
Chilled Water Return		Green	White	Ch. Wtr Ret
Shop Compressed Air		Yellow	Black	Shop Air
Air-Instrument Controls		Green	White	Air-Inst Cont
Drain Line		Green	White	Drain
High Pressure Steam		Yellow	Black	H.P. _____*
High Pressure Condensate Return		Yellow	Black	H.P. Ret _____*
Medium Pressure Steam		Yellow	Black	M. P. Stm _____*
Medium Pressure Condensate Return		Yellow	Black	M.P. Ret _____*
Low Pressure Steam		Yellow	Black	L.P. Stm _____*
Low Pressure Condensate Return		Yellow	Black	L.P. Ret _____*
High Temperature Water Supply		Yellow	Black	H. Temp Wtr Sup
High Temperature Water Return		Yellow	Black	H. Temp Wtr Ret
Hot Water Heating Supply		Yellow	Black	H. W. Htg Sup
Hot Water Heating Return		Yellow	Black	H. W. Htg Ret

Gravity Condensate Return		Yellow	Black	Gravity Cond Ret
Pumped Condensate Return		Yellow	Black	Pumped Cond Ret
Vacuum Condensate Return		Yellow	Black	Vac Cond Ret
Boiler Water Sampling		Yellow	Black	Sample
Continuous Blow-Down		Yellow	Black	Cont. B D
Pumped Condensate			Black	Pump Cond
Pump Recirculating		Yellow	Black	Pump-Recirc.
Vent Line		Yellow	Black	Vent
Cold Water (Domestic)	White	Green	White	C.W. Dom
Hot Water (Domestic)				
Supply	White	Yellow	Black	H.W. Dom
Return	White	Yellow	Black	H.W. Dom Ret
Tempered Water	White	Yellow	Black	Temp. Wtr
Sanitary Waste		Green	White	San Waste
Sanitary Vent		Green	White	San Vent
Storm Drainage		Green	White	St Drain
Pump Drainage		Green	White	Pump Disch
Chemical Resistant Pipe				
Waste		Yellow	Black	Acid Waste
Vent		Yellow	Black	Acid Vent
Atmospheric Vent		Green	White	ATV
Fuel Gas		Yellow	Black	Gas
Fire Protection Water				
Sprinkler		Red	White	Auto Spr
Standpipe		Red	White	Stand
Sprinkler		Red	White	Drain
Hot Water Supply Domestic/Solar Water			H.W. Sup Dom/SW	
Hot Water Return Domestic/Solar Water			H.W. Ret Dom/SW	

7. Electrical Conduits containing feeders over 600 volts, paint legends using 50 mm (2 inch) high black numbers and letters, showing the voltage class rating. Provide legends where conduits pass through walls and floors and at maximum 6100 mm (20 foot) intervals in between. Use labels with yellow background with black border and words Danger High Voltage Class, 5000.
8. See Sections for methods of identification, legends, and abbreviations of the following:
  - a. Regular compressed air lines: Section 22 15 00, GENERAL SERVICE COMPRESSED-AIR SYSTEMS.
  - b. Medical Gases and vacuum lines: Section 22 62 00, VACUUM SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES / Section 22 63 00, GAS SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES.
  - c. Conduits containing high voltage feeders over 600 volts: Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS / Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS / Section 28 05 33, RACEWAYS AND BOXES FOR ELECTRONIC SAFETY AND SECURITY.

B. Fire and Smoke Partitions:

1. Identify partitions above ceilings on both sides of partitions except within shafts in letters not less than 64 mm (2 1/2 inches) high.
2. Stenciled message: "SMOKE BARRIER" or, "FIRE BARRIER" as applicable.

3. Locate not more than 6100 mm (20 feet) on center on corridor sides of partitions, and with a least one message per room on room side of partition.
4. Use semigloss paint of color that contrasts with color of substrate.

C. Identify columns in pipe basements and interstitial space:

1. Apply stenciled number and letters to correspond with grid numbering and lettering shown.
2. Paint numbers and letters 100 mm (4 inches) high, locate 450 mm (18 inches) below overhead structural slab.
3. Apply on four sides of interior columns and on inside face only of exterior wall columns.
4. Color:
  - a. Use black on concrete columns.
  - b. Use white or contrasting color on steel columns.

**3.12 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.

**3.13 EXTERIOR PAINT SCHEDULE**

A. Steel Substrates:

1. Water-Based Light Industrial Coating System:
  - a. Prime Coat: Primer, Epoxy, Anti-Corrosive, for Metal, MPI #101.
  - b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
  - c. Topcoat: Light industrial coating, exterior, water based, semi-gloss (Gloss Level 5), MPI #163.
  - d. Minimum System DFT: 5 mils (125 microns).
2. High-Build Epoxy System:
  - a. Prime Coat: Primer, Epoxy, Anti-Corrosive, for Metal, MPI #101.
  - b. Intermediate Coat: Epoxy, high-build, low gloss, MPI #108.
  - c. Topcoat: Epoxy, high-build, low gloss, MPI #108.
  - d. Minimum System DFT: 9.25 mils (235 microns).

B. Galvanized-Metal and Stainless Steel Substrates:

1. Water-Based Light Industrial Coating System:

- a. Prime Coat: Primer, rust-inhibitive, water-based, for Metal, MPI #107.
- b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
- c. Topcoat: Light industrial coating, exterior, water based, semi-gloss (Gloss Level 5), MPI #163.
- d. Minimum System DFT: 5 mils (125 microns).

### 3.14 INTERIOR PAINT SCHEDULE

#### A. Concrete Substrates, Traffic Surfaces:

1. Water-Based Clear Sealer System:
  - a. First Coat: Sealer, water based, for concrete floors, MPI #99.
  - b. Topcoat: Sealer, water based, for concrete floors, MPI #99.

#### B. Steel Substrates:

1. High-Performance Architectural Latex System:
  - a. Prime Coat: Shop-applied primer specified in Division 5 Section where substrate is specified.
  - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
  - c. Topcoat: Latex, interior, high performance architectural, semi-gloss (Gloss Level 3) MPI #139.
  - d. Minimum System DFT: 4 mils (100 microns).

#### C. Galvanized-Metal Substrates:

1. High-Performance Architectural Latex System:
  - a. Prime Coat: Primer, galvanized, water based, MPI #134.
  - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
  - c. Topcoat: Latex, interior, high performance architectural, semi-gloss (Gloss Level 3) MPI #139.
  - d. Minimum System DFT: 4 mils (100 microns).

#### D. Gypsum Board Substrates:

1. Institutional Low-Odor/VOC Latex System:
  - a. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #149.
  - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
  - c. Topcoat: Latex, interior, institutional low odor/VOC, flat (Gloss Level 1), MPI #143, or.
  - d. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3), MPI #145.
  - e. Minimum System DFT: 4 mils (100 microns).
2. High-Performance Architectural Latex System:
  - a. Prime Coat: Primer sealer, latex, interior, MPI #50.

- b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
  - c. Topcoat: Latex, interior, high performance architectural, semi-gloss (Gloss Level 3) MPI #139.
  - d. Minimum System DFT: 4 mils (100 microns).
3. High-Build Epoxy System:
- a. Prime Coat: Primer sealer, latex, interior, MPI #50.
  - b. Intermediate Coat: Epoxy, high-build, low gloss, MPI #108.
  - c. Topcoat: Epoxy, high-build, low gloss, MPI #108.
  - d. Minimum System DFT: 6 mils (150 microns).

### 3.15 HIGH-TEMPERATURE RESISTANT COATINGS

- A. Ferrous Metal Subject to Temperatures up to 1100 degrees F (590 degrees C):
- 1. Finish: Aluminum Paint, High Heat.
    - a. Primer, Intermediate Coat, and Topcoat: MPI #22
    - b. Minimum System DFT: As recommended by manufacturer.

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### APPENDIX

Paint or coating	Abbreviation
Acrylic Emulsion	AE (MPI 10 - flat/MPI 11 - semigloss/MPI 119 - gloss)
Alkyd Flat	AK (MPI 49)
Alkyd Gloss Enamel	G (MPI 48)
Alkyd Semigloss Enamel	SG (MPI 47)
Aluminum Paint	AP (MPI 1)
Cementitious Paint	CEP (TT-P-1411)
Exterior Latex	EL (MPI 10 - flat/MPI 11 - semigloss/MPI 119 - gloss)
Exterior Oil	EO (MPI 9 - gloss/MPI 8 - flat/MPI 94 - semigloss)
Epoxy Coating	EC (MPI 77 - walls, floors/MPI 108 - CMU, concrete)
Fire Retardant Paint	FR (MPI 67)
Fire Retardant Coating (Clear)	FC (MPI 66, intumescent type)
Floor Enamel	FE (MPI 27 - gloss/MPI 59 - eggshell)
Heat Resistant Paint	HR (MPI 22)
Latex Emulsion	LE (MPI 53 - flat/MPI 52 - eggshell/MPI 54 - semigloss/MPI 114 - gloss Level 6)
Latex Emulsion (Low VOC)	LE (MPI 143 - flat/MPI 145 - eggshell/MPI 147 - semigloss)
Latex Flat	LF (MPI 138)
Latex Gloss	LG (MPI 114)
Latex Semigloss	SG (MPI 141)
Latex Low Luster	LL (MPI 139 and MPI 140)
Plastic Floor Coating	PL
Polyurethane Varnish	PV (MPI 31 - gloss/MPI 71 - flat)
Rubber Paint	RF (CID-A-A-3120 - Paint for Swimming Pools (RF)).



Water Paint, Cement WPC (CID-A-A-1555 - Water Paint, Powder).  
Wood Stain WS (MPI 90)

Verify abbreviations used in the following coating sections:  
Section 09 96 59, HIGH-BUILD GLAZED COATINGS GC  
Section 09 94 19, MULTICOLOR INTERIOR FINISHING MC

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**SECTION 10 26 00**

**WALL AND DOOR PROTECTION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies handrail/wall guard combinations, corner guards and door protectors and high impact wall covering.

**1.2 RELATED WORK**

- A. Wall mounted stainless steel handrail: Section 05 50 00, METAL FABRICATIONS.
- B. Armor plates and kick plates not specified in this section: Section 08 71 00, DOOR HARDWARE.
- C. Color and texture of aluminum and resilient material: Section 09 06 00, SCHEDULE FOR FINISHES.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings: show design and installation details.
- C. Manufacturer's Literature and Data:
  - 1. Handrail/Wall Guard Combinations.
  - 2. Wall Guards.
  - 3. Corner Guards.
  - 4. Door Protectors.
  - 5. High Impact Wall covering.
- D. Test Report: Showing that resilient material complies with specified fire and safety code requirements.

**1.4 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° C (70 degrees F) for at least 48 hours prior to installation.

## 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 Society for Testing and Materials (ASTM):
1. A167-99(R2004) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
  2. B221-07 Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
  3. D256-06 Impact Resistance of Plastics
  4. D635-06 Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position
  5. E84-07 Surface Burning Characteristics of Building Materials
- C. The National Association of Architectural Metal Manufacturers (NAAMM):
1. AMP 500 Series Metal Finishes Manual
- D. National Fire Protection Association (NFPA):
1. 80-06 Standard for Fire Doors and Windows
- E. Society of American Automotive Engineers (SAE):
1. J 1545-05 Instrumental Color Difference Measurement for Exterior Finishes.
- F. Underwriters Laboratories Inc. (UL):
1. Annual Issue Building Materials Directory

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Stainless Steel: ASTM A167, Type 302B.
- B. Aluminum Extruded: ASTM B221, Alloy 6063, Temper T5 or T6.
- C. Resilient Material:
1. Extruded and injection molded polyethylene terephthalate glycol (PETG) meeting following requirements:
    - a. Polyvinyl chloride (PVC) free material.
    - b. Minimum impact resistance of 1197 ps (25 ft lbs per sq.ft) when tested in accordance with ASTM D256 (Izod impact, ft.lbs. per inch notch).
    - c. Class 1 (Class A) 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.

- d. Rated self extinguishing when tested in accordance with ASTM D635.
- e. Material shall be labeled and tested by Underwriters Laboratories or other approved independent testing laboratory.
- f. Integral color with all colored components matched in accordance with SAE J 1545 to within plus or minus 1.0 on the CIE-LCH scales.
- g. Same finish on exposed surfaces.

## 2.2 CORNER GUARDS

- A. Resilient, Shock-Absorbing Corner Guards: Flush mounted formed to profile shown.
  - 1. Snap-on corner guard formed from resilient material, minimum 2 mm (0.078-inch) thick, free floating on a continuous 1.6 mm (0.063-inch) thick extruded aluminum retainer. Design retainer used for flush mounted type to act as a stop for adjacent wall finish material. Provide appropriate mounting hardware, cushions and base plates as required.
  - 2. Provide factory fabricated end closure caps at top and bottom of surface mounted corner guards.
  - 3. Flush mounted corner guards installed on any fire rated wall shall maintain the fire rating of the wall. Provide fire test of proposed corner guard system to verify compliance.
    - a. Where insulating materials are an integral part of the corner guard system, the insulating materials shall be provided by the manufacturer of the corner guard system.
    - b. All exposed metal in fire rated assemblies shall have a paintable finish.

## 2.3 WALL GUARDS AND HANDRAILS

- A. Wall Guards and Handrails:
  - 1. Handrail/Wall Guard Combination: Solid wood handrail-wall guard combination, 140 mm (5-1/2 inch) high, factory or field mitered end caps. Rail is mounted on matching wood brackets with concealed fasteners, anchored to wall at maximum 802 mm (32 inches) on center.
    - a. Wood species: Refer to Section 09 06 00, SCHEDULE FOR FINISHES.
  - 2. Wall Guards (Crash Rails): Snap-on covers of resilient material, minimum 2.8 mm (0.110-inch) thick, shall be free-floated over 50 mm (two-inch) wide aluminum retainer clips, minimum 2.3 mm (0.090-inch) thick, anchored to wall at maximum 600 mm (24 inches) on center, supporting a continuous aluminum retainer, minimum 1.6 mm (0.062-inch) thick; or, shall be free-floated over a continuous extruded aluminum retainer, minimum (0.090-inch) thick anchored to wall at maximum 600 mm (24 inches) on center.

## 2.4 DOOR PROTECTION

- A. Materials:
  - 1. Resilient Material: Fabricate door protection items from polyethylene

- terephthalate glycol (PETG), PVC-free, resilient material, minimum 1.5 mm (0.060-inch) thick, as shown.
    - a. Bevel top and two edges.
    - b. Size (single doors): (250 mm) 10 inches by door width less 50 mm (2 inches).
    - c. Size (pair doors): (250 mm) 10 inches by door width less 25 mm (1 inch).
  - 2. Stainless Steel: Type 304, 1.27 mm (0.050 inch) thick, satin stainless steel finish (Builders Hardware Manufacturers Association (BHMA) No. 630).
    - a. Bevel top and two edges.
    - b. Size (single doors): (250 mm) 10 inches by door width less 50 mm (2 inches).
    - c. Size (pair doors): (250 mm) 10 inches by door width less 25 mm (1 inch).
    - d. Provide stainless steel oval head screws, #6 x 5/8"
  - B. Coordinate door protection material requirements with door to insure fit for all components, and color as specified.
  - C. Provide adhesive as recommended by resilient material manufacturer.
- 2.5 HIGH IMPACT WALL COVERING (WALL GUARD)**
- A. Materials:
    - 1. Fabricate from polyethylene terephthalate glycol (PETG), PVC-free, resilient material minimum 6mm (0.20 inch) thick designed specially for interior use.
    - 2. Bevel top edge of resilient wall covering.
  - B. Provide adhesive as recommended by the wall covering manufacturer.
- 2.6 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, submit shop drawings showing proposed installation details.
- 2.7 FINISH**
- A. In accordance with NAAMM AMP 500 series.
  - B. Stainless Steel: NAAMM finish Number 4.
  - C. Resilient Material: Color as specified in Section 09 06 00, SCHEDULE FOR FINISHES.
  - D. Wood: Manufacturer's standard clear finish, shop-applied.

**PART 3 - INSTALLATION**

**3.1 RESILIENT CORNER GUARDS**

- A. Install corner guards on walls in accordance with manufacturer's instructions.

**3.2 SOLID WOOD HANDRAIL - WALL GUARD COMBINATIONS**

- A. Secure guards to walls with brackets and fasteners in accordance with manufacturer's details and instructions.

**3.3 DOOR PROTECTION AND HIGH IMPACT WALL COVERING**

- A. Surfaces to receive protection shall 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 manufacturers specific instructions.
- C. Apply with adhesive in controlled environment according to manufacture's recommendations.
- D. Protection installed on fire rated doors and frames shall 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 12 36 00**

**COUNTERTOPS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies casework countertops.

**1.2 RELATED WORK**

- A. Color and patterns of plastic laminate: SECTION 09 06 00, SCHEDULE FOR FINISHES.
- B. Plumbing fixtures, traps, drains, faucets: DIVISION 22, PLUMBING.
- C. DIVISION 26, ELECTRICAL.

**1.3 SUBMITTALS**

- A. Submit in accordance with SECTION 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings
1. Show dimensions of section and method of assembly.
  2. Show details of construction at 1/2 scale.
- C. Samples:
1. 150 mm (6 inch) square samples each top.
  2. Front edge, back splash, end splash and core with surface material and booking.

**1.4 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. Composite Panel Association (CPA):
1. A208.1-99 Particleboard
- C. American Society of Mechanical Engineers (ASME):
1. A112.18.1-05 Plumbing Fixture Fittings
- D. American Society for Testing and Materials (ASTM):
1. D256-06 Pendulum Impact Resistance of Plastic
  2. D570-98(R2005) Water Absorption of Plastics

3. D638-03 Tensile Properties of Plastics
  4. D785-03 Rockwell Hardness of Plastics and Electrical Insulating Materials
  5. D790-07 Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
  6. D4690-99(2005) Urea-Formaldehyde Resin Adhesives
  7. G21-96 (R2002) Determining Resistance of Synthetic Polymeric Materials to Fungi
- E. Federal Specifications (FS):
1. A-A-1936 Adhesive, Contact, Neoprene Rubber
- F. U.S. Department of Commerce, Product Standards (PS):
1. PS 1-95 Construction and Industrial Plywood
- G. National Electrical Manufacturers Association (NEMA):
1. LD 3-05 High Pressure Decorative Laminates
  2. 3.1-95 Performance, Application, Fabrication, and Installation of High Pressure Decorative Laminates

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Plastic Laminate: NEMA LD 3.
1. Concealed backing sheet Type BKL.
  2. Decorative surfaces:
    - a. Flat components: Type GP-HGL.
    - b. Post forming: Type PF-HGP.
- B. Particleboard: CPA A208.1, Grade 2-M-2.
- |                                     |      |           |
|-------------------------------------|------|-----------|
| Rockwell hardness                   | 105  | ASTM D785 |
| Water absorption, 14 hours (weight) | .01% | ASTM D570 |
- C. Plywood: PS 1, Exterior type, veneer grade AC not less than five ply construction.
- D. Fasteners:
1. Metals used for welding same metal as materials joined.
  2. Use studs, bolts, spacers, threaded rods with nuts or screws suitable for materials being joined with metal splice plates, channels or other supporting shape.

E. Solid Polymer Material:

1. Filled Methyl Methacrylic Polymer.
2. Performance properties required:

Property	Result	Test
Elongation	0.3% min.	ASTM D638
Hardness	90 Rockwell M	ASTM D785
Gloss (600 Gordon)	5-20	NEMA LD3.1
Color stability	No change	NEMA LD3 except 200 hour
Abrasion resistance	No loss of pattern - Max wear depth 0.0762 mm (0.003 in) - 10000 cycles	NEMA LD3
Water absorption weight (5 max)	24 hours 0.9	ASTM D-570
Izod impact	14 N·m/m - (0.25 ft-lb/in)	ASTM D256 - (Method A)
Impact resistance	No fracture	NEMA LD-3 900 mm (36") drop 1 kg - (2 lb.) ball
Boiling water surface resistance	No visible change	NEMA LD3
High temperature resistance	Slight surface dulling	NEMA LD3

3. Color throughout with subtle veining through thickness.
4. Dupont "Corian" is acceptable if meeting the above properties.
5. Joint adhesive and sealer: Manufacturers silicone adhesive and sealant for joining methyl methacrylic polymer sheet.

F. QUARTZ SURFACING

1. Homogeneous mixture containing 93 percent pure quartz with additions of high performance polyester resin, pigments and special effects.
2. Colors as indicated in Section 09 06 00, SCHEDULE FOR FINISHES.
3. Performance Characteristics:
  - a. Moisture Absorption (ASTM C97): Maximum 0.02 percent.
  - b. Modulus of Rupture (ASTM C99): Minimum 46.9 MPa (6,800 psi).
  - c. Compressive Strength (ASTM C170): Minimum 170.6 MPa (24,750 psi).
  - d. Abrasion Resistance (ASTM C501): Minimum 223.
  - e. Bond Strength (ASTM C482): 1,413 KPa (205 psi).
  - f. Thermal Shock (ASTM 484): passes 5 cycles:
  - g. Breaking Strength of Tile (ASTM C648): typical results 16.29 KN (3,661 lbf).

- h. Surface Burning Characteristics (ASTM E84): 25 or less.
- i. Smoke Developed (ASTM E84): 450 or less.
- j. Stain Resistance (ANSI Z124.6): Unaffected.

## **2.2 SINKS**

- A. As specified in DIVISION 22, PLUMBING.

## **2.3 TRAPS AND FITTINGS**

- A. As specified in DIVISION 22, PLUMBING.

## **2.4 WATER FAUCETS**

- A. As specified in DIVISION 22, PLUMBING.

## **2.5 COUNTERTOPS**

- A. Fabricate in largest sections practicable.
- B. Fabricate with joints flush on top surface.
- C. Fabricate countertops to overhang front of cabinets and end of assemblies 25 mm (one inch) except where against walls or cabinets.
- D. Fabricate with end splashes where against walls or cabinets as shown on Drawings.
- E. Drill or cutout for sinks, and penetrations.
  - 1. Accurately cut for size of penetration.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Before installing countertops verify that wall surfaces have been finished as specified and that mechanical and electrical service locations are as required.
- B. Secure countertops to supporting rails of cabinets with metal fastening devices, or screws through pierced slots in rails.
  - 1. Where type, size or spacing of fastenings is not shown or specified, submit shop drawings showing proposed fastenings and method of installation.
  - 2. Use round head bolts or screws.
  - 3. Use epoxy or silicone to fasten the epoxy resin countertops to the cabinets.
  - 4. Use wood or sheet metal screws for wood or plastic laminate tops; minimum penetration into top 16 mm (5/8 inch), screw size No 8, or 10.

**3.2 PROTECTION AND CLEANING**

- A. Tightly cover and protect against dirt, water, and chemical or mechanical injury.
- B. Clean at completion of work.

- - - E N D - - -

**SECTION 13 05 41**

**SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Provide gravity and seismic restraint in accordance with the requirements of this section in order to maintain the integrity of nonstructural components of the building so that they remain safe and functional in case of seismic event.
- B. Definitions: Non-structural building components are components or systems that are not part of the building's structural system whether inside or outside, above or below grade. Non-structural components of buildings include:
  - 1. Architectural Elements: Facades that are not part of the structural system and its shear resistant elements; cornices and other architectural projections and parapets that do not function structurally; glazing; nonbearing partitions; suspended ceilings; stairs isolated from the basic structure; cabinets; bookshelves; medical equipment; and storage racks.
  - 2. Electrical Elements: Power and lighting systems; substations; switchgear and switchboards; auxiliary engine-generator sets; transfer switches; motor control centers; motor generators; selector and controller panels; fire protection and alarm systems; special life support systems; and telephone and communication systems.
  - 3. Mechanical Elements: Heating, ventilating, and air-conditioning systems; medical gas systems; plumbing systems; sprinkler systems; steam piping; chilled water piping; pneumatic systems; boiler equipment and components.
  - 4. Transportation Elements: Mechanical, electrical and structural elements for transport systems, i.e., elevators and dumbwaiters, including hoisting equipment and counterweights.

**1.2 QUALITY CONTROL**

- A. Shop-Drawing Preparation:
  - 1. Have gravity support and seismic-force-restraint shop drawings and calculations prepared by a professional structural engineer experienced in the area of seismic force restraints. The professional structural engineer shall be registered in the state of California.
  - 2. Submit design tables and information used for the design-force levels, stamped and signed by a professional structural engineer registered in the State of California.

B. Coordination:

1. Do not install gravity supports or seismic restraints until submittals are approved by the Resident Engineer.
2. Coordinate and install trapezes or other multi-pipe hanger systems prior to pipe installation.

**1.3 SUBMITTALS**

A. Submit a coordinated set of equipment anchorage drawings prior to installation including:

1. Description, layout, and location of items to be anchored or braced with anchorage or brace points noted and dimensioned.
2. Details of anchorage or bracing at large scale with all members, parts brackets shown, together with all connections, bolts, welds etc. clearly identified and specified.
3. Numerical value of design seismic brace loads.
4. For expansion bolts, include design load and capacity if different from those specified.

B. Submit prior to installation, a coordinated set of bracing drawings for seismic protection of piping, with data identifying the various support-to-structure connections and seismic bracing structural connections, include:

1. Single-line piping diagrams on a floor-by-floor basis. Show all suspended piping for a given floor on the same plain.
2. Type of pipe (Copper, steel, cast iron, insulated, non-insulated, etc.).
3. Pipe contents.
4. Structural framing.
5. Location of all gravity load pipe supports and spacing requirements.
6. Numerical value of gravity load reactions.
7. Location of all seismic bracing.
8. Numerical value of applied seismic brace loads.
9. Type of connection (Vertical support, vertical support with seismic brace etc.).
10. Seismic brace reaction type (tension or compression). Details illustrating all support and bracing components, methods of connections, and specific anchors to be used.

C. Submit prior to installation, bracing drawings for seismic protection of suspended ductwork and suspended electrical and communication cables, include:

1. Details illustrating all support and bracing components, methods of connection, and specific anchors to be used.

2. Numerical value of applied gravity and seismic loads and seismic loads acting on support and bracing components.
  3. Maximum spacing of hangers and bracing.
  4. Seal of registered structural engineer responsible for design.
- D. Submit design calculations prepared and sealed by the registered structural engineer specified above in paragraph 1.3A.
- E. Submit for concrete anchors, the appropriate ICC evaluation reports, OSHPD pre-approvals, or lab test reports verifying compliance with OSHPD Interpretation of Regulations 28-6.

#### 1.4 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 basic designation only.
- B. American Concrete Institute (ACI):
- Building Code Requirements for Structural Concrete, (ACI 318-02), and Commentary (ACI 318R-02).
- C. American Institute of Steel Construction (AISC):
- Load and Resistance Factor Design, Volume 1, Second Edition.
- D. American Society for Testing and Materials (ASTM):
- A36/A36M-04.....Standard Specification for Carbon Structural Steel.
- A53/A53M-02.....Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- A307-03.....Standard Specification for Carbon Steel Bolts and Studs; 60,000 PSI Tensile Strength.
- A325-04.....Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
- A325M-04.....Standard Specification for High-Strength Bolts for Structural Steel Joints [Metric].
- A490-04.....Standard Specification for Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength.



- A490M-04.....Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints [Metric].
- A500-Rev.A-04.....Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- A501-01.....Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
- A615/615M-Rev.A-04.....Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- A992/A992M-04.....Standard Specification for Steel for Structural Shapes for Use in Building Framing.
- A996/996M-04.....Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.
- E488-96.....Standard Test Method for Strength of Anchors in Concrete and Masonry Elements.
- E. International Building Code (IBC) 2003 Edition.
- F. VA Seismic Design Requirements, H-18-8, current edition.
- G. National Uniform Seismic Installation Guidelines (NUSIG).
- H. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
- Seismic Restraint Manual - Guidelines for Mechanical Systems, 1998 Edition and Addendum.

### 1.5 Regulatory Requirement

- A. IBC 2006. I=1.5 for all structures, unless noted otherwise on the drawings.
- B. Short-period acceleration,  $S_{DS}$ , for use in calculation of seismic anchorage and bracing forces as required by the IBC, shall be taken as for that cited for the project location in VA document H-18-8.
- C. Exceptions: The seismic restraint of the following items may be omitted:
1. Equipment weighing less than 400 pounds, which is supported directly on the floor or roof.
  2. Equipment weighing less than 20 pounds, which is suspended from the roof or floor or hung from a wall.
  3. Gas and medical piping less than 2 1/2 inches inside diameter.

4. Piping in boiler plants and equipment rooms less than 1 1/4 inches inside diameter.
  5. All other piping less than 2 1/2 inches inside diameter, except for automatic fire suppression systems.
  6. All piping suspended by individual hangers, 12 inches or less in length from the top of pipe to the bottom of the support for the hanger.
  7. All electrical conduits, less than 2 1/2 inches inside diameter.
  8. All rectangular air handling ducts less than six square feet in cross sectional area.
  9. All round air handling ducts less than 28 inches in diameter.
  10. All ducts suspended by hangers 12 inches or less in length from the top of the duct to the bottom of support for the hanger.
- D. Mechanical and electrical equipment and components are to be seismically qualified/certified per ASCE 7-05 and as clarified in the Office of Statewide Health Planning and Development (OSHPD) Code Application Notice (CAN) No. 2-1708A.5

## **PART 2 - PRODUCTS**

### **2.1 STEEL**

- A. Structural Steel: ASTM A36.
- B. Structural Tubing: ASTM A500, Grade B.
- C. Steel Pipe: ASTM A53/A53M, Grade B.
- D. Bolts & Nuts: ASTM A307.

### **2.2 CAST-IN-PLACE CONCRETE**

- A. Concrete: 28 day strength,  $f'c = 27.5$  MPa (4,000 psi)
- B. Reinforcing Steel: ASTM A615/615M or ASTM A996/A996M deformed.

## **PART 3 - EXECUTION**

### **3.1 CONSTRUCTION, GENERAL**

- A. Provide equipment supports and anchoring devices to withstand the seismic and gravity design forces, so that when seismic design forces are applied, the equipment cannot displace, overturn, or become inoperable.
- B. Provide anchorages in conformance with recommendations of the equipment manufacturer and as shown on approved shop drawings and calculations.
- C. Construct seismic restraints and anchorage to allow for thermal expansion.

D. Testing Before Final Inspection:

1. Test 10-percent of anchors in masonry and concrete per ASTM E488, and ACI 355.2 to determine that they meet the required load capacity. If any anchor fails to meet the required load, test the next 20 consecutive anchors, which are required to have zero failure, before resuming the 10-percent testing frequency.
2. Before scheduling Final Inspection, submit a report on this testing indicating the number and location of testing, and what anchor-loads were obtained.

**3.2 EQUIPMENT RESTRAINT AND BRACING**

- A. See drawings for equipment to be restrained or braced.

**3.3 MECHANICAL DUCTWORK and piping; STEAM AND CHILLED WATER PIPING; boiler plant stacks and breaching; electrical busways, conduits, and cable trays; and telecommunication wires and cable trays**

- A. Support and brace mechanical ductwork and piping; electrical busways, conduits and cable trays; and telecommunication wires and cable trays including boiler plant stacks and breeching to resist directional forces (lateral, longitudinal and vertical).
- B. Brace duct and breeching branches with a minimum of 1 brace per branch.
- C. Provide supports and anchoring so that, upon application of seismic forces, piping remains fully connected as operable systems which will not displace sufficiently to damage adjacent or connecting equipment, or building members.
- D. Seismic Restraint of Piping:
1. Design criteria:
    - a. IBC 2006 seismic criteria.
- E. Piping Connections: Provide flexible connections where pipes connect to equipment. Make the connections capable of accommodating relative differential movements between the pipe and equipment under conditions of earthquake shaking.

**3.4 PARTITIONS**

- A. In buildings with flexible structural frames, anchor partitions to only structural element, such as a floor slab, and separate such partition by a physical gap from all other structural elements.
- B. Properly anchor masonry walls to the structure for restraint, so as to carry lateral loads imposed due to earthquake along with their own weight and other lateral forces.

**3.5 CEILINGS AND LIGHTING FIXTURES:**

- A. At regular intervals, laterally brace suspended ceilings against lateral and vertical movements, and provide with a physical separation at the walls.
- B. Independently support and laterally brace all lighting fixtures. Refer to applicable portion of lighting specification, Section 26 51 00, INTERIOR LIGHTING.

**3.6 FACADES AND GLAZING**

- A. Do not install concrete masonry unit filler walls in a manner that can restrain the lateral deflection of the building frame. Provide a gap with adequately sized resilient filler to separate the structural frame from the non-structural filler wall.
- B. Tie brick veneers to a separate wall that is independent of the steel frame as shown on construction drawings to ensure strength against applicable seismic forces at the project location.
- C. C. Install attachments to structure for all façade materials as shown on construction drawings to ensure strength against applicable seismic forces at the project location.

**3.7 STORAGE RACKS, CABINETS, AND BOOKCASES**

- A. Install storage racks to withstand earthquake forces and anchored to the floor or laterally braced from the top to the structural elements.
- B. Anchor medical supply cabinets to the floor or walls and equip them with properly engaged, lockable latches.
- C. Anchor filing cabinets that are more than 2 drawers high to the floor or walls, and equip all drawers with properly engaged, lockable latches.
- D. Anchor bookcases that are more than 30 inches high to the floor or walls, and equip any doors with properly engaged, lockable latches.

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**SECTION 21 05 11**

**COMMON WORK RESULTS FOR FIRE SUPPRESSION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

A. The requirements of this Section apply to all sections of Division 21.

B. Definitions:

1. Exposed: Piping and equipment exposed to view in finished rooms.
2. Option or optional: Contractor's choice of an alternate material or method.

**1.2 RELATED WORK**

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Excavation and Backfill: Section 31 20 00, EARTH MOVING.
- D. Concrete and Grout: Section 03 30 00, CAST-IN-PLACE CONCRETE.
- E. Building Components for Attachment of Hangers: Section 05 31 00, STEEL DECKING and Section 05 36 00, COMPOSITE METAL DECKING.
- F. Section 05 50 00, METAL FABRICATIONS.
- G. Section 07 84 00, FIRESTOPPING.
- H. Flashing for Wall and Roof Penetrations: Section 07 60 00, FLASHING AND SHEET METAL.
- I. Section 07 92 00, JOINT SEALANTS.
- J. Section 09 91 00, PAINTING.
- K. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS
- L. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

**1.3 QUALITY ASSURANCE**

A. 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. See other specification sections for any exceptions.
2. Equipment Service: Products shall be supported by a service organization which maintains a complete inventory of repair parts and is located reasonably close to the site.

3. 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.
  4. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
  5. 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.
  6. Asbestos products or equipment or materials containing asbestos shall not be used.
- B. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the Resident Engineer prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.
- C. Guaranty: Refer to Contract Documents.
- D. Supports for sprinkler piping shall be in conformance with NFPA 13.
- E. Supports for standpipe shall be in conformance with NFPA 14.

#### **1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data: Submit under the pertinent section rather than under this section.
  1. Equipment and materials identification.
  2. Fire-stopping materials.
  3. Hangers, inserts, supports and bracing. Provide load calculations for variable spring and constant support hangers.
  4. Wall, floor, and ceiling plates.
- C. Coordination Drawings: Provide detailed layout drawings of all piping systems. In addition provide details of the following.
  1. Mechanical equipment rooms.
  2. Interstitial space.
  3. Hangers, inserts, supports, and bracing.

4. Pipe sleeves.
  5. Equipment penetrations of floors, walls, ceilings, or roofs.
- D. 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.

#### 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):
- A36/A36M-2001.....Carbon Structural Steel
  - A575-96.....Steel Bars, Carbon, Merchant Quality, M-Grades R  
(2002)
  - E84-2003.....Standard Test Method for Burning Characteristics  
of Building Materials
  - E119-2000.....Standard Test Method for Fire Tests of Building  
Construction and Materials
- C. National Fire Protection Association (NFPA):
- 90A-09.....Installation of Air Conditioning and Ventilating  
Systems
  - 101-09.....Life Safety Code

### PART 2 - PRODUCTS

#### 2.1 LIFTING ATTACHMENTS

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.

#### 2.2 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 is specified in Section 09 91 00, PAINTING.
- 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. 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.
  - 2. 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.
  - 3. 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.

### **2.3 FIRESTOPPING**

Section 07 84 00, FIRESTOPPING specifies an effective barrier against the spread of fire, smoke and gases where penetrations occur for piping.

### **2.4 GALVANIZED REPAIR COMPOUND**

Mil. Spec. DOD-P-21035B, paint form.

### **2.5 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 this requirement must receive prior approval of Resident Engineer.
- 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, laundry work rooms, and animal rooms above basement. 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.

## **2.6 TOOLS AND LUBRICANTS**

- A. Furnish, and turn over to the Resident Engineer, special 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. Tool Containers: Hardwood or metal, permanently identified for in tended service and mounted, or located, where directed by the Resident Engineer.
- D. 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.

## **2.7 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. Use also where insulation ends on exposed water supply pipe drop from overhead. Provide a watertight joint in spaces where brass or steel pipe sleeves are specified.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Coordinate location of piping, sleeves, inserts, hangers, and equipment. Locate piping, sleeves, inserts, hangers, and equipment clear of windows, doors, openings, light outlets, and other services and utilities. Follow manufacturer's published recommendations for installation methods not otherwise specified.
- B. 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 Resident Engineer. Damaged or defective items in the opinion of the Resident Engineer, 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 equipment against dirt, water chemical, or mechanical injury. At completion of all work thoroughly exposed materials and equipment.
- C. Concrete and Grout: Use concrete and shrink compensating grout 25 MPa (3000 psi) minimum, specified in Section 03 30 00, CAST-IN-PLACE CONCRETE.
- D. Install gages, valves, and other devices with due regard for ease in reading or operating and maintaining said devices. Locate and position 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.

E. 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 Resident Engineer. Locate openings that will least effect structural slabs, columns, ribs or beams. Refer to the Resident Engineer for determination of proper design for openings through structural sections and opening layouts approval, prior to cutting or drilling into structure. After Resident Engineer's approval, carefully cut opening through construction no larger than absolutely necessary for the required installation.

F. Switchgear 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.

G. 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 LUBRICATION

Field check and lubricate equipment requiring lubrication prior to initial operation.

### **3.3 STARTUP AND TEMPORARY OPERATION**

Start up equipment as described in equipment specifications. Temporary use of equipment is specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT.

### **3.4 OPERATING AND PERFORMANCE TESTS**

- A. Prior to the final inspection, perform required tests as specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TESTS and submit the test reports and records to the Resident Engineer.
- 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.

### **3.5 INSTRUCTIONS TO VA PERSONNEL**

Provide in accordance with Article, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.

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**SECTION 21 13 13**

**WET-PIPE SPRINKLER SYSTEMS**

**PART 1 - GENERAL**

**1.1 SCOPE OF WORK**

- 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 system complete and ready for operation, for all portions of the Polytrauma and Blind Rehabilitation Building, including the mechanical equipment rooms, telephone rooms, elevator machine rooms, elevator pits, and linen chutes.

**1.2 RELATED WORK**

- A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Section 33 10 00, WATER UTILITIES.
- C. Section 07 84 00, FIRESTOPPING, Treatment of penetrations through rated enclosures.
- D. Section 09 91 00, PAINTING.
- E. Section 28 31 00, FIRE DETECTION AND ALARM, Connection to fire alarm of flow switches, pressure switches and valve supervisory switches.
- F. Section 21 05 11 COMMON WORK RESULTS FOR FIRE SUPPRESSION

**1.3 QUALITY ASSURANCE**

- A. Installer Reliability: The installer shall possess a valid State of California fire sprinkler contractor's license or approved equivalent. 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.
- C. Submittals: 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 practicing in the field of Fire Protection Engineering. As 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 index referencing the appropriate specification section. Submittals shall include, but not be limited to, the following:

1. Qualifications:
  - a. Provide a copy of the installing contractors fire sprinkler and state contractors 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 practicing in the field of Fire Protection Engineering.
2. Drawings: Submit detailed 1:100 (1/8 inch) scale (minimum) working drawings conforming to NFPA 13. Include a site plan showing the piping to the water supply test location.
3. Manufacturers Data Sheets:
  - 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: Submit hydraulic calculation sheets in tabular form conforming to the requirements and recommendations of NFPA 13.
5. 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. Submittals shall include, but not be limited to, the following:
  - a. One complete set of reproducible as-built drawings showing the installed system with the specific interconnections between the waterflow switch or pressure switch and the fire alarm equipment.
  - b. Complete, simple, understandable, step-by-step, testing instructions giving recommended and required testing frequency of all equipment, methods for testing all equipment, and a complete trouble shooting manual. Provide maintenance instructions on replacing any components of the system including internal parts, periodic cleaning and adjustment of the equipment and components with information as to the address and telephone number of both the manufacturer and the local supplier of each item.
  - c. 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.
  - d. Certificates shall document all parts of the installation.

- e. Instruction Manual: Provide one copy of the instruction manual covering the system in a flexible protective cover and mount in an accessible location adjacent to the riser.
- D. Design Basis Information: Provide design, materials, equipment, installation, inspection, and testing of the automatic sprinkler system in accordance with the requirements of NFPA 13. Recommendations in appendices shall be treated as requirements.
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: 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, Elevator Shafts, Elevator Machine Rooms, Refrigeration Service Rooms, 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).
    - d. Request clarification from the Government for any hazard classification not identified.
  3. Hydraulic Calculations: Calculated demand including hose stream requirements shall be no greater than 10 percent below the available water supply curve.
  4. Water Supply: Preliminary water supply is based on the following flow test of:
    - a. Location Fire Hydrant #7
    - b. Elevation Static Test Gauge Unknown ft
    - c. Elevation Residual Test Gauge Unknown ft
    - d. Static pressure: 85 psi
    - e. Residual pressure: 75 psi
    - f. Flow: 1,063 gpm
    - g. Date: February 24, 2009 Time 1:50 pm
  5. Zoning:
    - a. For each sprinkler zone provide a control valve, flow switch and a test and drain assembly with pressure gauge. Sprinkler zones in healthcare occupancies shall conform to the smoke barrier zones.
    - b. Sprinkler zones shall conform to the smoke barrier zones shown on the drawings.



- c. Provide seismic protection in accordance with NFPA 13.

#### **1.4 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):
- 13-2007.....Installation of Sprinkler Systems
  - 101-2006.....Safety to Life from Fire in Buildings and Structures (Life Safety Code)
  - 170-2006.....Fire Safety Symbols
- C. Underwriters Laboratories, Inc. (UL):
- Fire Protection Equipment Directory - 2008
- D. Factory Mutual Engineering Corporation (FM): Approval Guide - current online version
- E. International Building Code - 2006
- F. International Fire Code - 2006
- G. Foundation for Cross-Connection Control and Hydraulic Research-2005

#### **PART 2 - PRODUCTS**

##### **2.1 PIPING & FITTINGS**

- A. Sprinkler systems in accordance with NFPA 13 and VA Standards.

##### **2.2 VALVES**

- A. Valves in accordance with NFPA 13.
- B. Do not use quarter turn ball valves for 50 mm (2 inch) or larger drain valves.
- C. The wet system control valve shall be a listed indicating type valve. Control valve shall be UL Listed and 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).
- D. Automatic Ball Drips: Cast brass 20 mm (3/4 inch) in-line automatic ball drip with both ends threaded with iron pipe threads.

### **2.3 FIRE DEPARTMENT SIAMESE CONNECTION**

- A. Brass, flush wall type with a minimum of two 65 mm (2-1/2 inch) connections threaded to match those on the local fire protection service, with polished brass caps and chains. Provide escutcheon with integral raised letters "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.

### **2.4 SPRINKLERS**

- A. All sprinklers except "institutional" type sprinklers shall be FM approved. Provide quick response sprinklers in all areas, except where specifically prohibited by their listing or approval.
  - 1. Elevator shafts and elevator machine rooms: Standard response sprinklers.
  - 2. Elevator pit: sidewall 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, except as follows:
  - 1. Sprinklers in generator room: 286°F or 350°F rated.

### **2.5 SPRINKLER CABINET**

- A. Provide sprinkler cabinet with the required number of sprinkler heads of all ratings and types installed, and a sprinkler wrench for each system. Locate adjacent to the riser. Sprinkler heads shall be installed in center of tile or center to center.

### **2.6 IDENTIFICATION SIGNS/HYDRAULIC PLACARDS**

- A. Plastic, steel or aluminum signs with white lettering on a red background with holes for easy attachment. Enter pertinent data for each system on the hydraulic placard.

### **2.7 SWITCHES**

- A. Contain 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. Valve Supervisory Switches for Ball and Butterfly Valves: May be integral with the valve.

## **2.8 GAUGES**

- A. Provide gauges as required by NFPA 13.

## **2.9 PIPE hangers and SUPPORTS**

- 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.

## **2.10 WALL, FLOOR AND CEILING PLATES**

- A. Provide chrome plated steel escutcheon plates for exposed piping passing through walls, floors or ceilings.

## **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. Install 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. Locate piping in stairways 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). To prevent an obstruction to egress, provide piping clearances in accordance with NFPA 101.
- C. Welding: Conform to the requirements and recommendations of NFPA 13.
- D. Drains: 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.
- E. Supervisory Switches: Provide supervisory switches for sprinkler control valves.

- F. Waterflow Alarm Switches: Install waterflow switch and adjacent valves in easily accessible locations.
- G. Inspector's Test Connection: Install and supply in conformance 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. 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.
- J. Provide pressure gauge at each water flow alarm switch location and at each main drain connection.
- K. For each fire department connection, provide the symbolic sign given in NFPA 170 and locate 2400 to 3000 mm (8 to 10 feet) above each connection location. Size the sign to 450 by 450 mm (18 by 18 inches) with the symbol being at least 350 by 350 mm (14 by 14 inches).
- L. Firestopping shall comply with Section 07 84 00, FIRESTOPPING.
- M. Securely attach identification signs to control valves, drain valves, and test valves. Locate hydraulic placard information signs at each sectional control valve where there is a zone water flow switch.
- N. 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.

### **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 Technical Representative (COTR) 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 COTR/Resident Engineer 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 COTR/Resident Engineer.

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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. RE: Resident Engineer
  - 4. COTR: Contracting Officer's Technical Representative.

**1.2 RELATED WORK**

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Excavation and Backfill: Section 31 20 00, EARTH MOVING.
- D. Concrete and Grout: Section 03 30 00, CAST-IN-PLACE CONCRETE.
- E. Building Components for Attachment of Hangers: Section 05 31 00, STEEL DECKING, and Section 05 36 00, COMPOSITE METAL DECKING.
- F. Section 05 50 00, METAL FABRICATIONS.
- G. Section 07 84 00, FIRESTOPPING.
- H. Flashing for Wall and Roof Penetrations: Section 07 60 00, FLASHING AND SHEET METAL.
- I. Section 07 92 00, JOINT SEALANTS.
- J. Section 09 91 00, PAINTING.
- K. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.
- L. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS
- M. Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.

### 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 construction, as applicable.
- B. Flow Rate Tolerance for HVAC Equipment: Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.
- C. Equipment Vibration Tolerance:
1. Refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT. Equipment shall be factory-balanced to this tolerance and re-balanced on site, as necessary.
  2. After HVAC air balance work is completed and permanent drive sheaves are in place, perform field mechanical balancing and adjustments required to meet the specified vibration tolerance.
- D. 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. 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.
  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 Resident Engineer (RE)/Contracting Officers Technical Representative (COTR).
  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 reasonably close 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. Outside Steam Distribution Welding: Refer to Section 33 63 00, STEAM ENERGY DISTRIBUTION.
- H. 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 RE/COTR for resolution. **Provide written hard copies or computer files of manufacturer's installation instructions to the RE/COTR 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 RE/COTR 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.**
- I. Seismic Requirements:
1. Earthquake-resistive design shall comply with the latest editions of:
    - a. VA Handbook H-18-8, Seismic Design Requirements
    - b. IBC
    - c. ASCE-7



d. SMACNA

**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. 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.
- F. 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 approvals will be made only by groups.
- G. 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 Section 00 72 00, GENERAL CONDITIONS, Article, SUBCONTRACTS AND WORK COORDINATION.
  - 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. Hangers, inserts, supports, and bracing.

- c. Pipe sleeves.
  - d. Duct or equipment penetrations of floors, walls, ceilings, or roofs.
- H. Manufacturer's Literature and Data: Submit under the pertinent section rather than under this section.
- 1. Submit belt drive with the driven equipment. Submit selection data for specific drives when requested by the Resident Engineer.
  - 2. Submit electric motor data and variable speed drive data with the driven equipment.
  - 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.
- I. 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.
- J. 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):
- 430-09.....Central Station Air-Handling Units
- C. Rubber Manufacturers Association (ANSI/RMA):
- IP-20-2007.....Drives Using Classical V-Belts and Sheaves  
IP-21-2009.....Drives Using Double-V (Hexagonal) Belts
- D. Air Movement and Control Association (AMCA):
- 410-96.....Recommended Safety Practices for Air Moving  
Devices

E. American Society of Mechanical Engineers (ASME):

Boiler and Pressure Vessel Code (BPVC):

Section IX-2007.....Welding and Brazing Qualifications

B31.1-2007.....Power Piping, with Amendments

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

A36/A36M-08.....Carbon Structural Steel

A575-96(2007).....Steel Bars, Carbon, Merchant Quality, M-Grades R  
(2007)

E84-10.....Standard Test Method for Burning Characteristics  
of Building Materials

E119-2009c.....Standard Test Method for Fire Tests of Building  
Construction and Materials

G. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry, Inc:

SP-58-2009.....Pipe Hangers and Supports-Materials, Design and  
Manufacture

SP 69-2003.....Pipe Hangers and Supports-Selection and  
Application

SP 127-2001.....Bracing for Piping Systems, Seismic - Wind -  
Dynamic, Design, Selection, Application

H. National Fire Protection Association (NFPA):

70-08.....National Electrical Code

I. Military Specifications (Mil. Spec):

Mil Spec DoD P 21035B (Type 2)..Galvanized Repair Coating

J. 2006 International Building 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 RE/COTR. 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.

**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.
  5. Minimum Diameter of V-Belt Sheaves (ANSI/RMA recommendations) in millimeters and inches:

Fractional Horsepower		Standard		High Capacity	
Cross Section	Min. od mm (in)	Cross Section	Min. od mm (in)	Cross Section	Min. od mm (in)
2L	20 (0.8)	A	83 (3.25)	3V	67 (2.65)
3L	38 (1.5)	B	146 (5.75)	4V	180 (7.10)
4L	64 (2.5)	C	239 (9.40)	5V	318 (12.50)

Fractional Horsepower		Standard		High Capacity	
Cross Section	Min. od mm (in)	Cross Section	Min. od mm (in)	Cross Section	Min. od mm (in)
5L	89 (3.5)	D	345 (13.60)		
		E	554 (21.80)		

I. Drive Types, Based on ARI 430:

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; Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS; and, Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Provide all electrical wiring, conduit, and devices necessary for the proper connection, protection and operation of the systems. Provide special energy efficient motors as scheduled. Unless otherwise specified for a particular application use electric motors with the following requirements.
- B. Single-phase Motors: Capacitor-start type for hard starting applications. Motors for centrifugal fans and pumps may be split phase or permanent split capacitor (PSC).
- C. Poly-phase Motors: NEMA Design B, Squirrel cage, induction type. Each two-speed motor shall have two separate windings. Provide a time- delay (20 seconds minimum) relay for switching from high to low speed.
- D. Rating: Continuous duty at 100 percent capacity in an ambient temperature of 40 degrees centigrade (104 degrees F); minimum horsepower as shown on drawings; maximum horsepower in normal operation not to exceed nameplate rating without service factor.
- E. Special Requirements:
  - 1. Where motor power requirements of equipment furnished deviate from power shown on plans, provide electrical service designed under the requirements of NFPA 70 without additional time or cost to the Government.
  - 2. Assemblies of motors, starters, controls and interlocks on factory assembled and wired devices shall be in accordance with the requirements of this specification.
  - 3. Wire and cable materials specified in the electrical division of the specifications shall be modified as follows:
    - a. Wiring material located where temperatures can exceed 71 degrees C (160 degrees F) shall be stranded copper with Teflon FEP insulation with jacket..
    - b. Provide shielded conductors or wiring in separate conduits for all instrumentation and control systems where recommended by manufacturer of equipment.
  - 4. Select motor sizes so that the motors do not operate into the service factor at maximum required loads on the driven equipment. Motors on pumps shall be sized for non-overloading at all points on the pump performance curves.
  - 5. Motors utilized with variable frequency drives shall be rated "inverter-ready" per NEMA Standard, MG1, Part 31.4.4.2. Provide

motor shaft grounding apparatus that will protect bearings from damage from stray currents.

- F. Motor Efficiency and Power Factor: All motors, when specified as "high efficiency" by the project specifications on driven equipment, shall conform to efficiency and power factor requirements in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC, with no consideration of annual service hours. Motor manufacturers generally define these efficiency requirements as "NEMA premium efficient" and the requirements generally exceed those of the Energy Policy Act of 1992 (EPACT). Motors not specified as "high efficiency" shall comply with EPACT.
- G. Insulation Resistance: Not less than one-half meg-ohm between stator conductors and frame, to be determined at the time of final inspection.

## **2.7 VARIABLE SPEED MOTOR CONTROLLERS**

- A. Refer to Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS and Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS for specifications.
- B. The combination of controller and motor shall be provided by the manufacturer of the driven equipment, such as pumps and fans, and shall be rated for 100 percent output performance. Multiple units of the same class of equipment, i.e. air handlers, fans, pumps, shall be product of a single manufacturer.
- C. Motors shall be energy efficient type and be approved by the motor controller manufacturer. The controller-motor combination shall be guaranteed to provide full motor nameplate horsepower in variable frequency operation. Both driving and driven motor/fan sheaves shall be fixed pitch.
- D. Controller shall not add any current or voltage transients to the input AC power distribution system, DDC controls, sensitive medical equipment, etc., nor shall be affected from other devices on the AC power system.

## **2.8 EQUIPMENT AND MATERIALS IDENTIFICATION**

- A. Identification for piping is specified in Section 09 91 00, PAINTING.
- B. Provide bar code identification nameplate for all equipment which will allow the equipment identification code to be scanned into the system for maintenance and inventory tracking. Identification for piping is specified in Section 09 91 00, PAINTING.
- C. 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.
- D. 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.



- E. Control Items: Label all temperature and humidity sensors, controllers and control dampers. Identify and label each item as they appear on the control diagrams.
- F. Valve Tags and Lists:
  - 1. 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.
  - 2. 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.
  - 3. 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. Refer to Section 23 07 11, HVAC AND PLUMBING INSULATION, for firestop pipe and duct insulation.

## **2.10 GALVANIZED REPAIR COMPOUND**

- A. Mil. Spec. DOD-P-21035B, paint form.

## **2.11 HVAC PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS**

- A. Vibration Isolators: Refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
- B. Supports for Roof Mounted Items:
  - 1. Equipment: Equipment rails shall be galvanized steel, minimum 1.3 mm (18 gauge), with integral baseplate, continuous welded corner seams, factory installed 50 mm by 100 mm (2 by 4) treated wood nailer, 1.3 mm (18 gauge) galvanized steel counter flashing cap with screws, built-in cant strip, (except for gypsum or tectum deck), minimum height 280 mm (11 inches). For surface insulated roof deck, provide raised cant strip to start at the upper surface of the insulation.
  - 2. Pipe/duct pedestals: Provide a galvanized Unistrut channel welded to U-shaped mounting brackets which are secured to side of rail with galvanized lag bolts.
- C. 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.

- D. 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 Resident Engineer for each job condition, and shall be 2006 IBC compliant, especially suited for seismic and cracked concrete applications. ICC-ES ESR-1917 supports ACI 318 design.
  3. Power-driven fasteners: Permitted in existing concrete or masonry not less than 102 mm (four inches) thick when approved by the Resident Engineer for each job condition.
- E. 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.
- F. Attachment to Wood Construction: Wood screws or lag bolts.
- G. 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.
- H. 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.
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.
- I. Supports for Piping Systems:
1. Select hangers sized to encircle insulation on insulated piping. Refer to Section 23 07 11, HVAC AND PLUMBING INSULATION for insulation thickness. 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 (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. Saddle support: Type 36, 37 or 38.

- e. Turnbuckle: Types 13 or 15. Preinsulate.
- f. U-bolt clamp: Type 24.
- g. 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.
- h. Supports for plastic or glass piping: As recommended by the pipe manufacturer with black rubber tape extending one inch beyond steel support or clamp.

J. 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.

K. Seismic Restraint of Piping and Ductwork: Refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS. Comply with MSS SP-127.

**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 Resident Engineer.
- 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, laundry work rooms, and animal rooms above basement. 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 SPECIAL TOOLS AND LUBRICANTS**

- A. Furnish, and turn over to the RE/COTR, special 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. Tool Containers: Hardwood or metal, permanently identified for intended service and mounted, or located, where directed by the Resident Engineer.
- D. 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.

#### 2.14 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. Use also where insulation ends on exposed water supply pipe drop from overhead. Provide a watertight joint in spaces where brass or steel pipe sleeves are specified.

#### 2.15 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 RE/COTR 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 RE/COTR. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to RE/COTR 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 Interconnection of Controls and Instruments: This 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 Resident Engineer. Damaged or defective items in the opinion of the Resident Engineer 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. Switchgear 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.

M. 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 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 RE/COTR for evaluation prior to actual work.
- G. Restore building to original condition upon completion of rigging work.

**3.3 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 RE/COTR.
- 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 rests 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.
  4. 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.
  5. For seismic anchoring, refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.
- 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. Boiler foundations shall have horizontal dimensions that exceed boiler base frame dimensions by at least 150 mm (6 inches) on all sides. Refer to structural drawings. Bases shall be neatly finished and smoothed, shall have chamfered edges at the top, and shall be suitable for painting.

### **3.4 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. 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.

### **3.5 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: Refer to Section 09 91 00, PAINTING.

### **3.6 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.

### **3.7 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 RE/COTR 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.

### **3.8 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.

### **3.9 OPERATING AND PERFORMANCE TESTS**

- A. Prior to the final inspection, perform required tests as specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TESTS and submit the test reports and records to the RE/COTR.
- 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.

### **3.10 INSTRUCTIONS TO VA PERSONNEL**

- A. Provide in accordance with Article, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.

- - - E N D - - -

**SECTION 23 07 11**

**HVAC AND PLUMBING INSULATION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Field applied insulation for thermal efficiency and condensation control for:
1. HVAC piping, ductwork, refrigerant suction piping and steam/condensate piping and equipment not covered under Section 33 63 00, STEAM ENERGY DISTRIBUTION.
  2. Plumbing piping and equipment.
- B. Definitions
1. ASJ: All service jacket, white finish facing or jacket.
  2. Air conditioned space: Space having air temperature and/or humidity controlled by mechanical equipment.
  3. Cold: Equipment, ductwork or piping handling media at design temperature of 16 degrees C (60 degrees F) or below.
  4. Concealed: Ductwork and piping above ceilings and in chases, trenches and pipe spaces.
  5. Exposed: Piping, ductwork, and equipment exposed to view in finished areas including mechanical, and electrical equipment rooms or exposed to outdoor weather. Attics and crawl spaces where air handling units are located are considered to be mechanical rooms. Shafts, chases, unfinished attics, crawl spaces and pipe basements are not considered finished areas.
  6. FSK: Foil-scrim-kraft facing.
  7. Hot: HVAC Ductwork handling air at design temperature above 16 degrees C (60 degrees F); HVAC and plumbing equipment or piping handling media above 41 degrees C (105 degrees F).
  8. Density: kg/m<sup>3</sup> - kilograms per cubic meter (Pcf - pounds per cubic foot).
  9. Runouts: Branch pipe connections up to 25-mm (one-inch) nominal size to fan coil units or reheat coils for terminal units.
  10. Thermal conductance: Heat flow rate through materials.
    - a. Flat surface: Watt per square meter (BTU per hour per square foot).
    - b. Pipe or Cylinder: Watt per square meter (BTU per hour per linear foot).

11. Thermal Conductivity (k): Watt per meter, per degree C (BTU per inch thickness, per hour, per square foot, per degree F temperature difference).
12. HPS: High pressure steam (415 kPa [60 psig] and above).
13. HPR: High pressure steam condensate return.
14. MPS: Medium pressure steam (110 kPa [16 psig] thru 414 kPa [59 psig]).
15. MPR: Medium pressure steam condensate return.
16. LPS: Low pressure steam (103 kPa [15 psig] and below}.
17. LPR: Low pressure steam condensate gravity return.
18. PC: Pumped condensate.
19. HWH: Hot water heating supply.
20. HWHR: Hot water heating return.
21. CPD: Condensate pump discharge.
22. R: Pump recirculation.
23. FOS: Fuel oil supply.
24. FOR: Fuel oil return.
25. CW: Cold water.
26. CWR: Condenser water return.
27. CWS: Condenser water supply.
26. HW: Hot water.
27. CH: Chilled water supply.
28. CHR: Chilled water return.
29. RS: Refrigerant suction.
30. PVDC: Polyvinylidene chloride vapor retarder jacketing, white.
31. DX: Direct expansion (refrigerants).

## 1.2 RELATED WORK

- A. Section 07 84 00, FIRESTOPPING: Mineral fiber and bond breaker behind sealant.
- 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 05 11, COMMON WORK RESULTS FOR HVAC AND 33 63 00, STEAM ENERGY DISTRIBUTION: Piping and equipment.
- D. Section 22 05 19, METERS AND GAGES FOR PLUMBING PIPING and Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING: Hot and cold water piping.
- E. Section 23 64 00, PACKAGED WATER CHILLERS: Compressor, evaporator and piping.

- F. Section 23 23 00, REFRIGERANT PIPING: Requirements for refrigerant piping and fittings.
- G. Section 23 21 13, HYDRONIC PIPING and Section 23 22 13, STEAM AND CONDENSATE HEATING PIPING: Piping and equipment.
- H. Section 23 21 13, HYDRONIC PIPING: Chilled and heating hot water piping.
- I. Section 23 31 00, HVAC DUCTS AND CASINGS: Ductwork, plenum and fittings.
- J. Section 26 32 13, ENGINE GENERATORS: Exhaust stacks and muffler.

### 1.3 QUALITY ASSURANCE

- A. Refer to article QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

- B. Criteria:

- 1. Comply with NFPA 90A, particularly paragraphs 4.3.3.1 through 4.3.3.6, 4.3.10.2.6, and 5.4.6.4, parts of which are quoted as follows:

- 4.3.3.1 Pipe insulation and coverings, duct coverings, duct linings, vapor retarder facings, adhesives, fasteners, tapes, and supplementary materials added to air ducts, plenums, panels, and duct silencers used in duct systems, unless otherwise provided for in 4.3.3.1.2 or 4.3.3.1.3, shall have, in the form in which they are used, a maximum flame spread index of 25 without evidence of continued progressive combustion and a maximum smoke developed index of 50 when tested in accordance with NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*.

- 4.3.3.1.1 Where these products are to be applied with adhesives, they shall be tested with such adhesives applied, or the adhesives used shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when in the final dry state. (See 4.2.4.2.)

- 4.3.3.1.2 The flame spread and smoke developed index requirements of 4.3.3.1.1 shall not apply to air duct weatherproof coverings where they are located entirely outside of a building, do not penetrate a wall or roof, and do not create an exposure hazard.

- 4.3.3.1.3 Smoke detectors required by 6.4.4 shall not be required to meet flame spread index or smoke developed index requirements.

- 4.3.3.2 Closure systems for use with rigid and flexible air ducts tested in accordance with UL 181, Standard for Safety Factory-Made Air Ducts and Air Connectors, shall have been tested, listed, and used in accordance with the conditions of their listings, in accordance with one of the following:

- (1) UL 181A, Standard for Safety Closure Systems for Use with Rigid Air Ducts and Air Connectors

- (2) UL 181B, Standard for Safety Closure Systems for Use with Flexible Air Ducts and Air Connectors

- 4.3.3.3 Air duct, panel, and plenum coverings and linings, and pipe insulation and coverings shall not flame, glow, smolder, or smoke when tested in accordance with a similar test for pipe covering, ASTM C 411, Standard Test Method for Hot-Surface Performance of

High-Temperature Thermal Insulation, at the temperature to which they are exposed in service.

4.3.3.3.1 In no case shall the test temperature be below 121°C (250°F).

4.3.3.3.4 Air duct coverings shall not extend through walls or floors that are required to be fire stopped or required to have a fire resistance rating, unless such coverings meet the requirements of 5.4.6.4.

4.3.3.3.5\* Air duct linings shall be interrupted at fire dampers to prevent interference with the operation of devices.

4.3.3.3.6 Air duct coverings shall not be installed so as to conceal or prevent the use of any service opening.

4.3.10.2.6 Materials exposed to the airflow shall be noncombustible or limited combustible and have a maximum smoke developed index of 50 or comply with the following.

4.3.10.2.6.1 Electrical wires and cables and optical fiber cables shall be listed as noncombustible or limited combustible and have a maximum smoke developed index of 50 or shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance with NFPA 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

4.3.10.2.6.2 Pneumatic tubing for control systems shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance with UL 1820, Standard for Safety Fire Test of Pneumatic Tubing for Flame and Smoke Characteristics.

4.3.10.2.6.4 Optical-fiber and communication raceways shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance with UL 2024, Standard for Safety Optical-Fiber Cable Raceway.

4.3.10.2.6.6 Supplementary materials for air distribution systems shall be permitted when complying with the provisions of 4.3.3.

5.4.6.4 Where air ducts pass through walls, floors, or partitions that are required to have a fire resistance rating and where fire dampers are not required, the opening in the construction around the air duct shall be as follows:

- (1) Not exceeding a 25.4 mm (1 in.) average clearance on all sides
- (2) Filled solid with an approved material capable of preventing the passage of flame and hot gases sufficient to ignite cotton waste when subjected to the time-temperature fire conditions required for fire barrier penetration as specified in NFPA 251, *Standard Methods of Tests of Fire Endurance of Building Construction and Materials*

2. Test methods: ASTM E84, UL 723, or NFPA 255.

3. Specified k factors are at 24 degrees C (75 degrees F) mean temperature unless stated otherwise. Where optional thermal insulation material is used, select thickness to provide thermal conductance no greater than that for the specified material. For pipe, use insulation manufacturer's published heat flow tables. For domestic hot water supply and return, run out insulation and condensation control insulation, no thickness adjustment need be made.
  4. All materials shall be compatible and suitable for service temperature, and shall not contribute to corrosion or otherwise attack surface to which applied in either the wet or dry state.
- C. Every package or standard container of insulation or accessories delivered to the job site for use must have a manufacturer's stamp or label giving the name of the manufacturer and description of the material.

#### **1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings:
  1. All information, clearly presented, shall be included to determine compliance with drawings and specifications and ASTM, federal and military specifications.
    - a. Insulation materials: Specify each type used and state surface burning characteristics.
    - b. Insulation facings and jackets: Each type used. Make it clear that white finish will be furnished for exposed ductwork, casings and equipment.
    - c. Insulation accessory materials: Each type used.
    - d. Manufacturer's installation and fitting fabrication instructions for flexible unicellular insulation.
    - e. Make reference to applicable specification paragraph numbers for coordination.
- C. Samples:
  1. Each type of insulation: Minimum size 100 mm (4 inches) square for board/block/ blanket; 150 mm (6 inches) long, full diameter for round types.
  2. Each type of facing and jacket: Minimum size 100 mm (4 inches square).
  3. Each accessory material: Minimum 120 ML (4 ounce) liquid container or 120 gram (4 ounce) dry weight for adhesives / cement / mastic.

### 1.5 STORAGE AND HANDLING OF MATERIAL

- A. Store materials in clean and dry environment, pipe covering jackets shall be clean and unmarred. Place adhesives in original containers. Maintain ambient temperatures and conditions as required by printed instructions of manufacturers of adhesives, mastics and finishing cements.

### 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 basic designation only.
- B. Federal Specifications (Fed. Spec.):
- L-P-535E (2)-99.....Plastic Sheet (Sheeting): Plastic Strip; Poly (Vinyl Chloride) and Poly (Vinyl Chloride - Vinyl Acetate), Rigid.
- C. Military Specifications (Mil. Spec.):
- MIL-A-3316C (2)-90.....Adhesives, Fire-Resistant, Thermal Insulation
  - MIL-A-24179A (1)-87.....Adhesive, Flexible Unicellular-Plastic Thermal Insulation
  - MIL-PRF-19565C (1)-88...Coating Compounds, Thermal Insulation, Fire-and Water-Resistant, Vapor-Barrier
  - MIL-C-20079H-87.....Cloth, Glass; Tape, Textile Glass; and Thread, Glass and Wire-Reinforced Glass
- D. American Society for Testing and Materials (ASTM):
- C449-07.....Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
  - C518-10.....Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
  - C533-09.....Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
  - C547-07e1.....Standard Specification for Mineral Fiber pipe Insulation
  - C591-09.....Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
  - C612-10.....Standard Specification for Mineral Fiber Block and Board Thermal Insulation



- C1126-04.....Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation
- C1136-10.....Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
- D1668-97a (2006).....Standard Specification for Glass Fabrics (Woven and Treated) for Roofing and Waterproofing
- E84-10.....Standard Test Method for Surface Burning Characteristics of Building Materials
- E. National Fire Protection Association (NFPA):
  - 90A-09.....Installation of Air Conditioning and Ventilating Systems
  - 255-06.....Standard Method of tests of Surface Burning Characteristics of Building Materials
- F. Underwriters Laboratories, Inc (UL):
  - 723-08.....UL Standard for Safety Test for Surface Burning Characteristics of Building Materials
- G. Manufacturer's Standardization Society of the Valve and Fitting Industry (MSS):
  - SP58-2009.....Pipe Hangers and Supports Materials, Design, and Manufacture

## **PART 2 - PRODUCTS**

### **2.1 MINERAL FIBER**

- A. ASTM C612 (Board, Block), Class 1 or 2,  $k = 0.037$  Watt per meter, per degree C (0.26), external insulation for temperatures up to 204 degrees C (400 degrees F).
- B. ASTM C553 (Blanket, Flexible) Type I, Class B-3, Density  $16 \text{ kg/m}^3$  (1 pcf),  $k = 0.045$  (0.31), for use at temperatures up to 204 degrees C (400 degrees F)
- C. ASTM C547 (Pipe Fitting Insulation and Preformed Pipe Insulation), Class 1,  $k = 0.037$  (0.26) for use at temperatures 230 degrees C (450 degrees F).

### **2.2 RIGID CELLULAR PHENOLIC FOAM**

- A. Preformed (molded) pipe insulation, ASTM C1126, type III, grade 1,  $k = 0.021$ (0.15), for temperatures up to 121 degrees C (250 degrees F) with vapor retarder and all service jacket with polyvinyl chloride premolded fitting covering.

- B. Equipment and Duct Insulation, ASTM C 1126, type II, grade 1, k = 0.021 (0.15), for temperatures up to 121 degrees C (250 degrees F) with rigid cellular phenolic insulation and covering, vapor retarder and all service jacket.

**2.3 CELLULAR GLASS CLOSED-CELL**

- A. Comply with Standard ASTM C177, C518, density 120 kg/m<sup>3</sup> (7.5 pcf) nominal, k = 0.033 (0.29) at 0 degrees C (75 degrees F).
- B. Pipe insulation for temperatures up to 200 degrees C (400 degrees F).

**2.4 POLYISOCYANURATE CLOSED-CELL RIGID**

- A. Preformed (fabricated) pipe insulation, ASTM C591, type IV, K=0.027 (0.19), for use at temperatures up to 149 degree C (300 degree F) with factory applied PVDC or all service jacket vapor retarder with polyvinyl chloride pre-molded fitting covers.
- B. Equipment and duct insulation, ASTM C 591, type IV, K=0.027(0.19), for use at temperatures up to 149 degrees C (300 degrees F) with PVDC or all service jacket vapor retarder jacket.

**2.5 FLEXIBLE ELASTOMERIC CELLULAR THERMAL**

- A. ASTM C177, C518, k = 0.039 Watt per meter, per degree C (0.27), at 24 degrees C (75 degrees F), flame spread not over 25, smoke developed not over 50, for temperatures from minus 4 degrees C (40 degrees F) to 93 degrees C (200 degrees F). No jacket required.

**2.6 CALCIUM SILICATE**

- A. Preformed pipe Insulation: ASTM C533, Type 1 and Type II with indicator denoting asbestos-free material.
- B. Pre-molded Pipe Fitting Insulation: ASTM C533, Type and Type II with indicator denoting asbestos-free material.
- C. Equipment Insulation: ASTM C533, Type I and Type II
- D. Characteristics:

<b>Insulation Characteristics</b>		
<b>ITEMS</b>	<b>TYPE I</b>	<b>TYPE II</b>
Temperature, maximum degrees C (degrees F)	649 (1200)	927 (1700)
Density (dry), Kg/m <sup>3</sup> (lb/ ft <sup>3</sup> )	232 (14.5)	288 (18)
Thermal conductivity: Min W/ m K (Btu in/h ft <sup>2</sup> degrees F)@	0.059	0.078

mean temperature of 93 degrees C (200 degrees F)	(0.41)	(0.540)
Surface burning characteristics:		
Flame spread Index, Maximum	0	0
Smoke Density index, Maximum	0	0

## 2.7 INSULATION FACINGS AND JACKETS

- A. Vapor Retarder, higher strength with low water permeance  $\leq$  0.02 or less perm rating, Beach puncture 50 units for insulation facing on exposed ductwork, casings and equipment, and for pipe insulation jackets. Facings and jackets shall be all service type (ASJ) or PVDC Vapor Retarder jacketing.
- B. ASJ jacket shall be white kraft bonded to 0.025 mm (1 mil) thick aluminum foil, fiberglass reinforced, with pressure sensitive adhesive closure. Comply with ASTM C1136. Beach puncture 5 units, Suitable for painting without sizing. Jackets shall have minimum 40 mm (1-1/2 inch) lap on longitudinal joints and minimum 100 mm (4 inch) butt strip on end joints. Butt strip material shall be same as the jacket. Lap and butt strips shall be self-sealing type with factory-applied pressure sensitive adhesive.
- C. Vapor Retarder medium strength with low water vapor permeance of 0.02 or less perm rating), Beach puncture 25 units: Foil-Scrim-Kraft (FSK) or PVDC vapor retarder jacketing type for concealed ductwork and equipment.
- D. Glass Cloth Jackets: Presized, minimum 0.18 kg per square meter (7.8 ounces per square yard), 2000 kPa (300 psig) bursting strength with integral vapor retarder where required or specified. Weather proof if utilized for outside service.
- E. Factory composite materials may be used provided that they have been tested and certified by the manufacturer.
- F. Pipe fitting insulation covering (jackets): Fitting covering shall be premolded to match shape of fitting and shall be polyvinyl chloride (PVC) conforming to Fed Spec L-P-535, composition A, Type II Grade GU, and Type III, minimum thickness 0.7 mm (0.03 inches). Provide color matching vapor retarder pressure sensitive tape.
- G. Aluminum Jacket-Piping systems and circular breeching and stacks: ASTM B209, 3003 alloy, H-14 temper, 0.6 mm (0.023 inch) minimum thickness with locking longitudinal joints. Jackets for elbows, tees and other fittings shall be factory-fabricated to match shape of fitting and of 0.6 mm (0.024) inch minimum thickness aluminum. Fittings shall be of same construction as

straight run jackets but need not be of the same alloy. Factory-fabricated stainless steel bands shall be installed on all circumferential joints. Bands shall be 20 mm (0.75 inch) wide on 450 mm (18 inch) centers. System shall be weatherproof if utilized for outside service.

- H. Aluminum jacket-Rectangular breeching: ASTM B209, 3003 alloy, H-14 temper, 0.5 mm (0.020 inches) thick with 32 mm (1-1/4 inch) corrugations or 0.8 mm (0.032 inches) thick with no corrugations. System shall be weatherproof if used for outside service.

## 2.8 PIPE COVERING PROTECTION SADDLES

- A. Cold pipe support: Premolded pipe insulation 180 degrees (half-shells) on bottom half of pipe at supports. Material shall be cellular glass of the same thickness as adjacent insulation.

Nominal Pipe Size and Accessories Material (Insert Blocks)	
Nominal Pipe Size mm (inches)	Insert Blocks mm (inches)
Up through 125 (5)	150 (6) long
150 (6)	150 (6) long
200 (8), 250 (10), 300 (12)	225 (9) long
350 (14), 400 (16)	300 (12) long
450 through 600 (18 through 24)	350 (14) long

- B. Warm or hot pipe supports: Premolded pipe insulation (180 degree half-shells) on bottom half of pipe at supports. Material shall be cellular glass or calcium silicate. Insulation at supports shall have same thickness as adjacent insulation.

## 2.9 ADHESIVE, MASTIC, CEMENT

- A. Mil. Spec. MIL-A-3316C, Class 1: Jacket and lap adhesive and protective finish coating for insulation.
- B. Mil. Spec. MIL-A-3316C, Class 2: Adhesive for laps and for adhering insulation to metal surfaces.
- C. Mil. Spec. MIL-A-24179A, Type II Class 1: Adhesive for installing flexible unicellular insulation and for laps and general use.
- D. Mil. Spec. MIL-C-19565C, Type I: Protective finish for outdoor use.
- E. Mil. Spec. MIL-C-19565C, Type I or Type II: Vapor barrier compound for indoor use.
- F. ASTM C449: Mineral fiber hydraulic-setting thermal insulating and finishing cement.

G. Other: Insulation manufacturers' published recommendations.

#### **2.10 MECHANICAL FASTENERS**

- A. Pins, anchors: Welded pins, or metal or nylon anchors with tin-coated or fiber washer, or clips. Pin diameter shall be as recommended by the insulation manufacturer.
- B. Staples: Outward clinching monel or stainless steel.
- C. Wire: 1.3 mm thick (18 gage) soft annealed galvanized or 1.9 mm (14 gage) copper clad steel or nickel copper alloy.
- D. Bands: 20 mm (3/4 inch) nominal width, brass, galvanized steel, aluminum or stainless steel.

#### **2.11 REINFORCEMENT AND FINISHES**

- A. Glass fabric, open weave: ASTM D1668, Type III (resin treated) and Type I (asphalt treated).
- B. Glass fiber fitting tape: Mil. Spec MIL-C-20079H, Type II, Class 1.
- C. Tape for Flexible Elastomeric Cellular Insulation: As recommended by the insulation manufacturer.
- D. Hexagonal wire netting: 25 mm (one inch) mesh, 0.85 mm thick (22 gage) galvanized steel.
- E. Corner beads: 50 mm (2 inch) by 50 mm (2 inch), 0.55 mm thick (26 gage) galvanized steel; or, 25 mm (1 inch) by 25 mm (1 inch), 0.47 mm thick (28 gage) aluminum angle adhered to 50 mm (2 inch) by 50 mm (2 inch) Kraft paper.
- F. PVC fitting cover: Fed. Spec L-P-535, Composition A, 11-86 Type II, Grade GU, with Form B Mineral Fiber insert, for media temperature 4 degrees C (40 degrees F) to 121 degrees C (250 degrees F). Below 4 degrees C (40 degrees F) and above 121 degrees C (250 degrees F). Provide double layer insert. Provide color matching vapor barrier pressure sensitive tape.

#### **2.12 FIRESTOPPING MATERIAL**

- A. Other than pipe and duct insulation, refer to Section 07 84 00 FIRESTOPPING.

#### **2.13 FLAME AND SMOKE**

- A. Unless shown otherwise all assembled systems shall meet flame spread 25 and smoke developed 50 rating as developed under ASTM, NFPA and UL standards and specifications. See paragraph 1.3 "Quality Assurance".

### **PART 3 - EXECUTION**

#### **3.1 GENERAL REQUIREMENTS**

- A. Required pressure tests of duct and piping joints and connections shall be completed and the work approved by the Resident Engineer for application

- of insulation. Surface shall be clean and dry with all foreign materials, such as dirt, oil, loose scale and rust removed.
- B. Except for specific exceptions, insulate entire specified equipment, piping (pipe, fittings, valves, accessories), and duct systems. Insulate each pipe and duct individually. Do not use scrap pieces of insulation where a full length section will fit.
- C. Insulation materials shall be installed in a first class manner with smooth and even surfaces, with jackets and facings drawn tight and smoothly cemented down at all laps. Insulation shall be continuous through all sleeves and openings, except at fire dampers and duct heaters (NFPA 90A). Vapor retarders shall be continuous and uninterrupted throughout systems with operating temperature 16 degrees C (60 degrees F) and below. Lap and seal vapor barrier over ends and exposed edges of insulation. Anchors, supports and other metal projections through insulation on cold surfaces shall be insulated and vapor sealed for a minimum length of 150 mm (6 inches).
- D. Install vapor stops at all insulation terminations on either side of valves, pumps and equipment and particularly in straight lengths of pipe insulation.
- E. Construct insulation on parts of equipment such as chilled water pumps and heads of chillers, convertors and heat exchangers that must be opened periodically for maintenance or repair, so insulation can be removed and replaced without damage. Install insulation with bolted 1 mm thick (20 gage) galvanized steel or aluminum covers as complete units, or in sections, with all necessary supports, and split to coincide with flange/split of the equipment.
- F. Insulation on hot piping and equipment shall be terminated square at items not to be insulated, access openings and nameplates. Cover all exposed raw insulation with white sealer or jacket material.
- G. Protect all insulation outside of buildings with aluminum jacket using lock joint or other approved system for a continuous weather tight system. Access doors and other items requiring maintenance or access shall be removable and sealable.
- H. HVAC work not to be insulated:
1. Internally insulated ductwork and air handling units.
  2. Relief air ducts (Economizer cycle exhaust air).
  3. Exhaust air ducts and plenums, and ventilation exhaust air shafts.
  4. Equipment: Expansion tanks, flash tanks, hot water pumps, steam condensate pumps.

5. In hot piping: Unions, flexible connectors, control valves, PRVs, safety valves and discharge vent piping, vacuum breakers, thermostatic vent valves, steam traps 20 mm (3/4 inch) and smaller. Insulate piping to within approximately 75 mm (3 inches) of uninsulated items.

I. Plumbing work not to be insulated:

1. Piping and valves of fire protection system.
2. Chromium plated brass piping.
3. Water piping in contact with earth.
4. Piping in pipe basement serving wall hydrants.
5. Small horizontal cold water branch runs in partitions to individual fixtures may be without insulation for maximum distance of 900 mm (3 feet).
3. Equipment:
  - a. Condensate return pump units
  - b. Safety valves
  - c. Water meters
  - d. Air compressors and tanks
  - e. Refrigerated or desiccant air drier
  - f. Chemical feeders
  - g. All nameplates
4. Specialties:
  - a. Pressure reducing valves
  - b. Control valves-water and steam
  - c. Level sensors-piping, valves and blowdown
  - d. Strainers under 65 mm (2-1/2 inch) pipe size
  - e. Expansion bellows
  - f. Flexible connectors
  - g. Ball joints except piping between joints

J. Apply insulation materials subject to the manufacturer's recommended temperature limits. Apply adhesives, mastic and coatings at the manufacturer's recommended minimum coverage.

K. Elbows, flanges and other fittings shall be insulated with the same material as is used on the pipe straights. The elbow/ fitting insulation shall be field-fabricated, mitered or factory prefabricated to the necessary size and shape to fit on the elbow/ fitting. Use of polyurethane spray-foam to fill a PVC elbow jacket is prohibited on cold applications.

- L. Firestop Pipe and Duct insulation:
  - 1. Provide firestopping insulation at fire and smoke barriers through penetrations. Fire stopping insulation shall be UL listed as defines in Section 07 84 00, FIRESTOPPING.
  - 2. Pipe and duct penetrations requiring fire stop insulation including, but not limited to the following:
    - a. Pipe risers through floors
    - b. Pipe or duct chase walls and floors
    - c. Smoke partitions
    - d. Fire partitions
- M. Provide metal jackets over insulation as follows:
  - a. All piping and ducts exposed to outdoor weather.
  - b. A 50 mm (2 inch) overlap is required at longitudinal and circumferential joints.

### 3.2 INSULATION INSTALLATION

- A. Mineral Fiber Board:
  - 1. Faced board: Apply board on pins spaced not more than 300 mm (12 inches) on center each way, and not less than 75 mm (3 inches) from each edge of board. In addition to pins, apply insulation bonding adhesive to entire underside of horizontal metal surfaces. Butt insulation edges tightly and seal all joints with laps and butt strips. After applying speed clips cut pins off flush and apply vapor seal patches over clips.
  - 2. Plain board:
    - a. Insulation shall be scored, beveled or mitered to provide tight joints and be secured to equipment with bands spaced 225 mm (9 inches) on center for irregular surfaces or with pins and clips on flat surfaces. Use corner beads to protect edges of insulation.
    - b. For hot equipment: Stretch 25 mm (1 inch) mesh wire, with edges wire laced together, over insulation and finish with insulating and finishing cement applied in one coat, 6 mm (1/4 inch) thick, trowel led to a smooth finish.
    - c. For cold equipment: Apply meshed glass fabric in a tack coat 1.5 to 1.7 square meter per liter (60 to 70 square feet per gallon) of vapor mastic and finish with mastic at 0.3 to 0.4 square meter per liter (12 to 15 square feet per gallon) over the entire fabric surface.
    - d. Chilled water pumps; condenser water pumps: Insulate with removable and replaceable 1 mm thick (20 gage) aluminum or galvanized steel



covers lined with insulation. Seal closure joints/flanges of covers with gasket material. Fill void space in enclosure with flexible mineral fiber insulation.

3. Exposed, unlined ductwork and equipment in unfinished areas, mechanical and electrical equipment rooms and attics, and duct work exposed to outdoor weather:
  - a. 50 mm (2 inch) thick insulation faced with ASJ (white all service jacket): Supply air duct.
  - b. 40 mm (1-1/2 inch) thick insulation faced with ASJ: Return air duct.
  - c. Outside air intake ducts: no insulation required.
4. Cold equipment: 40 mm (1-1/2 inch) thick insulation faced with ASJ.
  - a. Chilled water pumps, condenser water pumps, water filter, chemical feeder pot or tank.
5. Hot equipment: 40 mm (1-1/2 inch) thick insulation faced with ASJ.
  - a. Convertors, air separators, steam condensate pump receivers.
  - b. Domestic water heaters and hot water storage tanks (not factory insulated).

B. Flexible Mineral Fiber Blanket:

1. Adhere insulation to metal with 100 mm (4 inch) wide strips of insulation bonding adhesive at 200 mm (8 inches) on center all around duct. Additionally secure insulation to bottom of ducts exceeding 600 mm (24 inches) in width with pins welded or adhered on 450 mm (18 inch) centers. Secure washers on pins. Butt insulation edges and seal joints with laps and butt strips. Staples may be used to assist in securing insulation. Seal all vapor retarder penetrations with mastic. Sagging duct insulation will not be acceptable. Install firestop duct insulation where required.
2. Supply air ductwork to be insulated includes main and branch ducts from AHU discharge to room supply outlets, and the bodies of ceiling outlets to prevent condensation. Insulate sound attenuator units, coil casings and damper frames. To prevent condensation insulate trapeze type supports and angle iron hangers for flat oval ducts that are in direct contact with metal duct.
3. Concealed supply air ductwork.
  - a. Above ceilings at a roof level: 50 mm (2 inch) thick insulation faced with FSK.
  - b. Above ceilings for other than roof level: 40 mm (1 ½ inch) thick insulation faced with FSK.

4. Concealed return air duct above ceilings at a roof level, unconditioned areas, and in chases with external wall or containing steam piping; 40 mm (1-1/2 inch) thick, insulation faced with FSK. Concealed return air ductwork in other locations need not be insulated.
  5. Concealed outside air duct: 40 mm (1-1/2 inch) thick insulation faced with FSK.
  7. Exhaust air branch duct from autopsy refrigerator to main duct: 40 mm (1-1/2 inch) thick insulation faced with FSK.
- C. Molded Mineral Fiber Pipe and Tubing Covering:
1. Fit insulation to pipe or duct, aligning longitudinal joints. Seal longitudinal joint laps and circumferential butt strips by rubbing hard with a nylon sealing tool to assure a positive seal. Staples may be used to assist in securing insulation. Seal all vapor retarder penetrations on cold piping with a generous application of vapor barrier mastic. Provide inserts and install with metal insulation shields at outside pipe supports. Install freeze protection insulation over heating cable.
  2. Contractor's options for fitting, flange and valve insulation:
    - a. Insulating and finishing cement for sizes less than 100 mm (4 inches) operating at surface temperature of 16 degrees C (61 degrees F) or more.
    - b. Factory premolded, one piece PVC covers with mineral fiber, (Form B), inserts. Provide two insert layers for pipe temperatures below 4 degrees C (40 degrees F), or above 121 degrees C (250 degrees F). Secure first layer of insulation with twine. Seal seam edges with vapor barrier mastic and secure with fitting tape.
    - c. Factory molded, ASTM C547 or field mitered sections, joined with adhesive or wired in place. For hot piping finish with a smoothing coat of finishing cement. For cold fittings, 16 degrees C (60 degrees F) or less, vapor seal with a layer of glass fitting tape imbedded between two 2 mm (1/16 inch) coats of vapor barrier mastic.
    - d. Fitting tape shall extend over the adjacent pipe insulation and overlap on itself at least 50 mm (2 inches).

3. Nominal thickness in millimeters and inches specified in table below,  
 for piping above ground:

<b>Nominal Thickness of Molded Mineral Fiber Insulation</b>				
Nominal Pipe Size, millimeters (inches):	25 (1) & below	32- 75 (1-1/4- 3)	100-150 (4-6)	200 (8) and above
a. 122-177 degrees C (251-350 F) (HPS, MPS,)	50 (2.0)	65 (2.5)	90 (3.5)	90 (3.5)
b. 100-121 degrees C HPR, MPR (212-250 degrees F) (Vent piping from PRV safety valves and condensate receivers)	25 (1.0)	50 (2.0)	50 (2.0)	50 (2.0)
c. 38-99 degrees C (100-211 degrees F) (LPR, PC, HWH, HWHR,	25 (1.0)	40 (1.5)	50 (2.0)	50 (2.0)
1. Runouts to fan coil units	15 (0.5)			
2. Runouts to reheat coils air terminal unit reheat coils	15 (0.5)	-	-	-
d. Domestic hot water supply and return	15 (0.5)	20(0.75)	25 (1.0)	40 (1.5)

D. Rigid Cellular Phenolic Foam:

1. Rigid closed cell phenolic insulation may be provided for piping,  
 ductwork and equipment for temperatures up to 121 degrees C (250 degrees  
 F) .
2. Note the NFPA 90A burning characteristics requirements of 25/50 in  
 paragraph 1.3.B
3. Provide secure attachment facilities such as welding pins.
4. Apply insulation with joints tightly drawn together
5. Apply adhesives, coverings, neatly finished at fittings, and valves.
6. Final installation shall be smooth, tight, neatly finished at all edges.

7. Minimum thickness in millimeters (inches) specified in table below, for piping above ground:

<b>Nominal Thickness of Rigid Closed-Cell Phenolic Foam Insulation</b>					
Nominal Pipe Size millimeters (inches):	25 (1) & below	32-75 (1 1/4-3)	100-150 (4-6)	200-300 (8-12)	350 (14) & above
1. 100-121 degrees C (212-250 degrees F), LPS, Vent piping from receivers.	15 (0.5)	25 (1)	25 (1)	--	--
2. 38-99 degrees C (100-211 degrees F), LPR, PC, HWH, HWHR, GH and GHR.	15 (0.5)	20 (0.75)	25 (1)	--	--
a. Run outs to Fan Coil units, reheat coils.	15 (0.5)	--	--	--	--
3. 4-16 degrees C (40-60 degrees F), CH, CHR, CWS, CWR,	20 (0.75)	20 (0.75)	25 (1)	40 (1.5)	50 (2.0)
a. Run outs to Fan Coil Units.	15 (0.5)	--	--	--	--
4. 10 degrees C (50 degrees F) and less, RS for DX refrigerants.	15 (0.5)	20 (0.75)	--	--	--
5. Domestic hot water supply and return.	15 (0.5)	15 (0.5)	20 (0.75)	20 (0.75)	--

8. Condensation control insulation: Minimum 20 mm (0.75 inch) thick for all pipe sizes.

a. HVAC: Cooling coil condensation piping to waste piping fixture or drain inlet. Omit insulation on plastic piping in mechanical rooms.

b. Plumbing piping as follows:

- 1) Body of roof and overflow drains horizontal runs and offsets (including elbows) of interior downspout piping in all areas above pipe basement.
- 2) Waste piping from electric water coolers and icemakers to drainage system.
- 3) Waste piping located above basement floor from ice making and film developing equipment and air handling units, from fixture (including trap) to main vertical waste pipe.

4) Cold water piping.

E. Cellular Glass Insulation:

1. Pipe and tubing, covering nominal thickness in millimeters and inches as tabulated below for chilled water and refrigerant piping.

<b>Nominal Thickness of Cellular Glass Insulation</b>				
Millimeters (inches)	Thru 38 (1 1/2)	50- 150 (2-6)	200-300 (8-12)	over 350 (14)
1. 4-16 degrees C (40-60 degrees F) (CH, CHR, CWS, and CWR within chiller room and pipe chase and underground)	50 (2.0)	80 (3.0)	80 (3.0)	100 (4.0)
2. 4-16 degrees C (40-60 degrees F) (CH, CHR, CWS, and CWR outside chiller room)	40 (1.5)	50 (2.0)	50 (2.0)	65 (2.5)

2. Cold equipment: 50 mm (2 inch) thick insulation faced with ASJ for chilled water pumps, condenser water pumps, water filters, chemical feeder pots or tanks, expansion tanks, air separators and air purgers.

F. Polyisocyanurate Closed-Cell Rigid Insulation (Outdoor Use Only):

1. Polyisocyanurate closed-cell rigid insulation (PIR) may be provided for piping, equipment and ductwork for temperature up to 149 degree C (300 degree F) provided insulation thickness requirement does not exceed 38 mm (1.5 inches).
2. Install insulation, vapor retarder and jacketing per manufacturer's recommendations. Particular attention should be paid to recommendations for joint staggering, adhesive application, external hanger design, expansion/contraction joint design and spacing and vapor retarder integrity.
3. Install insulation with all joints tightly butted (except expansion joints in hot applications).
4. If insulation thickness exceeds 63 mm (2.5 inches), install as a double layer system with longitudinal (lap) and butt joint staggering as recommended by manufacturer.
5. For cold applications, vapor retarder shall be installed in a continuous manner. No staples, rivets, screws or any other attachment device capable of penetrating the vapor retarder shall be used to attach the vapor retarder or jacketing. No wire ties capable of penetrating the vapor

- retarder shall be used to hold the insulation in place. Banding shall be used to attach PVC or metal jacketing.
6. Elbows, flanges and other fittings shall be insulated with the same material as is used on the pipe straights. The elbow/ fitting insulation shall be field-fabricated, mitered or factory prefabricated to the necessary size and shape to fit on the elbow/ fitting. Use of polyurethane spray-foam to fill PVC elbow jacket is prohibited on cold applications.
  7. For cold applications, the vapor retarder on elbows/fittings shall be either mastic-fabric-mastic or 2 mil thick PVDC vapor retarder adhesive tape.
  8. All PVC and metal jacketing shall be installed so as to naturally shed water. Joints shall point down and shall be sealed with either adhesive or caulking (except for periodic slip joints).
  9. Underground piping: Follow instructions for above ground piping but the vapor retarder jacketing shall be 6 mil thick PVDC or minimum 30 mil thick rubberized bituminous membrane. Sand bed and backfill shall be a minimum of 150 mm (6 inches) all around insulated pipe.
  10. Note the NFPA 90A burning characteristic requirements of 25/50 in paragraph 1.3B. Refer to paragraph 3.1 for items not to be insulated.
  11. Minimum thickness in millimeter (inches) specified in table below, for piping:

<b>Nominal Thickness of Polyisocyanurate Rigid Insulation</b>				
Nominal Pipe Size millimeters(inches):	25(1) & below	32-75 (1 1/4-3)	100-150 (4-6)	200-300 (8-12)
1. 122-149 degree C(251-300 degree F) (HPS, MPS)	40 (1.5)	--	--	--
2. 100-121 degrees C (211-250 degrees F), HPR, MPR, LPS, Vent piping from receivers and flash tanks	20 (0.75)	40(1.5)	40(1.5)	40(1.50)
3. 38-99 degrees C (100-211 degrees F), LPR, PC, HWH, and HWHR	20 (0.75)	25(1.0)	40(1.5)	40(1.50)

<b>Nominal Thickness of Polyisocyanurate Rigid Insulation</b>				
a. Run outs to fan coil units	20 (0.75)	--	--	--
4. 4-16 degrees C (40-60 degrees F), CH, CHR, CWS and CWR for relative humidity up to 80 percent or underground location	25 (1.00)	25 (1.0)	40 (1.50)	40 (1.5)
a. Run outs to fan coil units	20 (0.75)	25 (1.)	--	--
5. 4-16 degrees C (40-60 degrees F) CH, CHR, CWS, and CWR for relative humidity 80 to 90 percent or higher	40 (1.50)	40 (1.5)	40 (1.5)	40 (1.5)
a. Run out to fan coils units	40 (1.5)	40 (1.5)	--	--
6. 10 degrees C (50 degrees F) and less, RS for DX refrigerants	20 (0.75)	25 (1.0)	--	--
7. Domestic hot water supply and return	15 (0.5)	20 (0.74)	25 (1.0)	25 (1.0)

12. Condensation control insulation: Minimum 20 mm (0.75 inch) thick for all pipe sizes.
- a. HVAC: Cooling coil condensation piping to waste piping fixture or drain inlet. Omit insulation on plastic piping in mechanical rooms.
  - b. Plumbing piping as follows:
    - 1) Body of roof and overflow drains and horizontal runs and offsets (including elbows) of interior downspout piping in all areas above pipe basement.
    - 2) Waste piping from electric water coolers to drainage system.
    - 3) Cold Water Piping.

G. Flexible Elastomeric Cellular Thermal Insulation:

1. Apply insulation and fabricate fittings in accordance with the manufacturer's installation instructions and finish with two coats of weather resistant finish as recommended by the insulation manufacturer.
2. Pipe and tubing insulation:
  - a. Use proper size material. Do not stretch or strain insulation.
  - b. To avoid undue compression of insulation, provide cork stoppers or wood inserts at supports as recommended by the insulation manufacturer. Insulation shields are specified under Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.
  - c. Where possible, slip insulation over the pipe or tubing prior to connection, and seal the butt joints with adhesive. Where the slip-on technique is not possible, slit the insulation and apply it to the pipe sealing the seam and joints with contact adhesive. Optional tape sealing, as recommended by the manufacturer, may be employed. Make changes from mineral fiber insulation in a straight run of pipe, not at a fitting. Seal joint with tape.
3. Apply sheet insulation to flat or large curved surfaces with 100 percent adhesive coverage. For fittings and large pipe, apply adhesive to seams only.
4. Pipe insulation: nominal thickness in millimeters (inches as specified in table below for piping above ground:

<b>Nominal Thickness of Flexible Elastomeric Cellular Insulation</b>				
Nominal Pipe Size millimeters (inches)	25 (1) & below	32-75 (1 1/4-3)	100-150 (4-6)	200 (8)
1. 38-93 degrees C (100-200 degrees F) (HWH, HWHR,)	25 (1.0)	40 (1.5)	-	-
a. Runouts to fan coil units, reheat coils, air terminal unit reheat coils	20 (0.75)	40 (1.5)	-	-
2. 4-16 degrees C (40-60 degrees F) (CH, CHR, CWS, CWR)	25 (1.0)	40 (1.5)	-	-



<b>Nominal Thickness of Flexible Elastomeric Cellular Insulation</b>				
Nominal Pipe Size millimeters (inches)	25 (1) & below	32-75 (1 1/4-3)	100-150 (4-6)	200 (8)
a. Runouts to fan coil units, cooling coil condensate piping	20 (0.75)	40 (1.5)	-	-
b. RS for DX refrigeration	25 (1.0)	40 (1.5)	-	-
3. Domestic hot water supply and return	15 (0.50)	20 (0.75)	25 (1.0)	40 (1.50)

5. Minimum 20 mm (0.75 inch) thick insulation for pneumatic control lines for a minimum distance of 6 m (20 feet) from discharge side of the refrigerated dryer.
6. Use Class S (Sheet), 20 mm (3/4 inch) thick for the following:
  - a. Chilled water pumps; condenser water pumps.
  - b. Bottom and sides of metal basins for winterized cooling towers (where basin water is heated).
  - c. Chillers, insulate any cold chiller surfaces subject to condensation which has not been factory insulated.
  - d. Piping inside refrigerators and freezers: Provide heat tape under insulation.

H. Calcium Silicate:

1. Minimum thickness in millimeter (inches) specified below for piping other than in boiler plant.

<b>Nominal Thickness Of Calcium Silicate Insulation (Non-Boiler Plant)</b>				
Nominal Pipe Size Millimeters (Inches)	Thru 25 (1)	32 to 75 (1-1/4 to 3)	100-200 (4 to 6)	Over 200 (6)
93-260 degrees C(200-500 degrees F) (HPS, HPR)	67 (2-1/2)	75(3)	100(4)	100(4)

2. Engine Exhaust Insulation for Emergency Generator and Diesel Driven Fire Pump: Type II, Class D, 65 mm (2 1/2 inch) nominal thickness. Cover exhaust completely from engine through roof or wall construction, including muffler. Secure with 16 AWG galvanized annealed wire or 0.38 x 12 mm 0.015 x 1/2 IN wide galvanized bands on 300 mm 12 IN maximum centers. Anchor wire and bands to welded pins, clips or angles. Apply 25 mm 1 IN hex galvanized wire over insulation. Fill voids with 6 mm 1/4 IN insulating cement.

**3.3 APPLICATION -TRENCH AND MANHOLE, PIPE, VALVES, STRAINERS AND FITTINGS  
(EXCLUDING STEAM ENERGY DISTRIBUTION, WHICH IS COVERED UNDER 33 63 00):**

- A. Temperature range 120 to 230 degrees C (251 to 450 degrees F);
  1. Application; Steam service 110 kpa (16 psig nominal) and higher, high pressure condensate to trap assembly.
  2. Insulation and Jacket:
    - a. Calcium silicate for piping in manholes.
    - b. Mineral fiber for remaining locations.
    - c. ASJ with PVC premolded fitting coverings.
  3. Thickness:

<b>Nominal Thickness Of Calcium Silicate Insulation (Boiler Plant)</b>	
<b>Pipe Diameter mm (in)</b>	<b>Insulation Thickness mm (in)</b>
25 (1) and below	50 (2)
32 to 80 (1 to 3)	63 (2-1/2)
100 (4) and above	88 (3-1/2)

- B. Temperature range 100 to 121 degrees C (211 to 250 degrees F):
  1. Application: Steam service 103 kpa (15 psig) and below, trap assembly discharge piping.
  2. Insulation and Jacket:
    - a. Calcium silicate for piping in manholes.
    - b. Mineral Fiber or rigid closed cell phenolic foam for remaining locations.
    - c. ASJ with PVC premolded fitting coverings.

3. Thickness-calcium silicate and mineral fiber insulation:

Nominal Thickness Of Insulation	
Pipe Diameter mm (in)	Insulation Thickness mm (in)
25 (1) and below	25 (1)
32 to 80 (1-1/4 to 3)	50 (2)
100 (4) and above	50 (2)

4. Thickness-rigid closed-cell phenolic foam insulation:

Nominal Thickness Of Insulation	
Pipe Diameter mm (in)	Insulation Thickness mm (in)
25 (10 and below)	19 (0.75)
32 to 80 (1-1/4 to 30)	25 (1)
100 (4) and above	25 (1)

C. Temperature range 32 to 99 degrees C (90 to 211 degrees F):

1. Application: Pumped condensate, gravity and pumped heating returns, condensate transfer, condensate transfer pump recirculation, condensate return from convertors and heated water storage tanks.
2. Insulation Jacket:
  - a. Calcium silicate for piping in manholes.
  - b. Mineral fiber or rigid closed-cell phenolic foam for remaining locations.
  - c. ASJ with PVC premolded fitting coverings.
3. Thickness-calcium silicate and mineral fiber insulation:

Nominal Thickness Of Insulation	
Pipe Diameter mm (in)	Insulation Thickness mm (in)
25 (1) and below	25 (1)
32 to 80 (1-1/4 to 3)	38 (1-1/2)
100 (40 and above)	50 (2)

4. Thickness-rigid closed-cell phenolic foam insulation:

Nominal Thickness Of Insulation	
Pipe Diameter mm (in)	Insulation Thickness mm (in)
25 (1) and below	19 (0.75)
32 to 80 (1-1/4 to 3)	19 (0.75)
100 (4) and above	25 (1)

D. Protective insulation to prevent personnel injury:

1. Insulation thickness: 25 mm (1 inch).
2. Insulation and jacket: Calcium silicate with ASJ except provide aluminum jacket on piping at boilers within 1800 mm (6 feet) of floor. Use PVC premolded fitting coverings when all service jacket is utilized.

E. Installation:

1. At pipe supports, weld pipe covering protection saddles to pipe, except where MS-SP58, type 3 pipe clamps are utilized.
2. Insulation shall be firmly applied, joints butted tightly, mechanically fastened by stainless steel wires on 300 mm (12 inch) centers.
3. At support points, fill and thoroughly pack space between pipe covering protective saddle bearing area.
4. Terminate insulation and jacket hard and tight at anchor points.
5. Terminate insulation at piping facilities not insulated with a 45 degree chamfered section of insulating and finishing cement covered with jacket.
6. On calcium silicate, mineral fiber and rigid closed-cell phenolic foam systems, insulated flanged fittings, strainers and valves with sections of pipe insulation cut, fitted and arranged neatly and firmly wired in place. Fill all cracks, voids and coat outer surface with insulating cement. Install jacket. Provide similar construction on welded and threaded fittings on calcium silicate systems or use premolded fitting insulation.
7. On mineral fiber systems, insulate welded and threaded fittings more than 50 mm (2 inches) in diameter with compressed blanket insulation (minimum 2/1) and finish with jacket or PVC cover.
8. Insulate fittings 50 mm (2 inches) and smaller with mastic finishing material and cover with jacket.
9. Insulate valve bonnet up to valve side of bonnet flange to permit bonnet flange removal without disturbing insulation.

10. Install jacket smooth, tight and neatly finish all edges. Over wrap ASJ butt strips by 50 percent. Secure aluminum jacket with stainless steel bands 300 mm (12 inches) on center or aluminum screws on 200 mm (4 inch) centers.
11. Do not insulate basket removal flanges on strainers.

- - - E N D - - -

**SECTION 23 37 00**  
**AIR OUTLETS AND INLETS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

A. Air outlets and inlets, including the following:

**1.2 RELATED WORK**

- A. Seismic Reinforcing: Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.
- B. General Mechanical Requirements: Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- C. Noise Level Requirements: Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
- D. Testing and Balancing of Air Flows: Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

**1.3 QUALITY ASSURANCE**

- A. Refer to article, QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Fire Safety Code: Comply with NFPA 90A.

**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. Air intake/exhaust hoods.
  - 2. Perforated distribution plates.
  - 3. Diffusers, registers, grilles and accessories.
- C. Coordination Drawings: Refer to article, SUBMITTALS, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

**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 Diffusion Council Test Code:
  - 1062 GRD-84.....Certification, Rating, and Test Manual 4<sup>th</sup> Edition

- C. American Society of Civil Engineers (ASCE):  
ASCE7-05.....Minimum Design Loads for Buildings and Other  
Structures
- D. American Society for Testing and Materials (ASTM):  
B209-07.....Standard Specification for Aluminum and  
Aluminum-Alloy Sheet and Plate  
E84-10.....Standard Test Method for Surface Burning  
Characteristics of Building Materials
- E. National Fire Protection Association (NFPA):  
90A-09.....Standard for the Installation of Air Conditioning  
and Ventilating Systems
- F. Underwriters Laboratories, Inc. (UL):  
181-05.....Factory Made Air Ducts and Connectors

## **PART 2 - PRODUCTS**

### **2.1 EQUIPMENT SUPPORTS**

- A. Refer to Section 21 05 11, COMMON WORK RESULTS FOR FIRE SUPPRESSION, Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, and Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

### **2.2 AIR OUTLETS AND INLETS**

- A. Materials:
  - 1. Steel or aluminum. Provide manufacturer's standard gasket. Furnish aluminum air outlets and inlets for use in damp areas such as shower rooms and kitchens.
  - 2. Exposed Fastenings: The same material as the respective inlet or outlet. Fasteners for aluminum may be stainless steel.
  - 3. Contractor shall review all ceiling drawings and details and provide all ceiling mounted devices with appropriate dimensions and trim for the specific locations.
- B. Performance Test Data: In accordance with Air Diffusion Council Code 1062GRD. Refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT for NC criteria.
- C. Air Supply Outlets:
  - 1. Ceiling Diffusers: Suitable for surface mounting, exposed T-bar or special tile ceilings, off-white finish, square or round neck connection as shown on the drawings. Provide plaster frame for units in plaster ceilings.

- a. Square, louver, fully adjustable pattern: Round neck, surface mounting unless shown otherwise on the drawings. Provide equalizing or control grid and volume control damper.
  - b. Louver face type: Square or rectangular, removable core for 1, 2, 3, or 4 way directional pattern. Provide equalizing or control grid and opposed blade damper.
  - c. Perforated face type: Manual adjustment for one-, two-, three-, or four-way horizontal air distribution pattern without change of air volume or pressure. Provide equalizing or control grid and opposed blade over overlapping blade damper. Perforated face diffusers for VAV systems shall have the pattern controller on the inner face, rather than in the neck and designed to discharge air horizontally at the ceiling maintaining a Coanda effect.
2. Slot diffuser/plenum:
- a. Galvanized steel boot lined with 13 mm (1/2 inch) thick fiberglass conforming to NFPA 90A and complying with UL 181 for erosion. Form slots or use adjustable pattern controllers, to provide stable, horizontal air flow pattern over a wide range of operating conditions.
  - b. Provide inlet connection diameter equal to duct diameter shown on drawings or provide transition coupling if necessary.
  - c. Maximum pressure drop at design flow rate: 37 Pa (0.15 inch) W.G.
3. Linear Grilles and Diffusers: Extruded aluminum, manufacturer's standard finish, and positive holding concealed fasteners.
- a. Margin: Flat, 20 mm (3/4 inch) wide.
  - b. Bars: Minimum 5 mm (3/16 inch) wide by 20 mm (3/4 inch) deep, zero deflection unless otherwise shown. Reinforce bars on 450 mm (18 inch) center for sidewall units and on 150 mm (6 inch) center for units installed in floor or sills.
  - c. Provide opposed blade damper and equalizing or control grid where required.
4. Registers: Double deflection type with horizontal face bars and opposed blade damper with removable key operator.
- a. Margin: Flat, 30 mm (1-1/4 inches) wide.
  - b. Bar spacing: 20 mm (3/4 inch) maximum.
  - c. Finish: Off white baked enamel for ceiling mounted units. Wall units shall have a prime coat for field painting, or shall be extruded with manufacturer's standard finish.



5. Grilles: Same as registers but without the opposed blade damper.
- D. Return and Exhaust Registers and Grilles: Provide opposed blade damper without removable key operator for registers.
  1. Finish: Off-white baked enamel for ceiling mounted units. Wall units shall have a prime coat for field painting, or shall be extruded aluminum with manufacturer's standard aluminum finish.
  2. Standard Type: Fixed horizontal face bars set at 30 to 45 degrees, approximately 30 mm (1-1/4 inch) margin.
  3. Perforated Face Type: To match supply units.
  4. Grid Core Type: 13 mm by 13 mm (1/2 inch by 1/2 inch) core with 30 mm (1-1/4 inch) margin.
  5. Linear Type: To match supply units.
  6. Door Grilles: Are furnished with the doors. (Coordinate w/Architect).
  7. Filter Grilles: Standard face hinged to a mounting frame with space for a 25 mm (one inch) throwaway filter. Hold face closed by a locking screw. Provide retaining clips to hold filter in place. Provide one inch thick fiberglass throwaway filter.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Comply with provisions of Section 23 05 11, COMMON WORK RESULTS FOR HVAC, particularly regarding coordination with other trades and work in existing buildings.
- B. Protection and Cleaning: Adequately protect equipment and materials against physical damage. Place equipment in first class operating condition, or return to source of supply for repair or replacement, as determined by Resident Engineer. Protect equipment during construction against entry of foreign matter to the inside and clean both inside and outside before operation and painting.

#### **3.2 TESTING, ADJUSTING AND BALANCING (TAB)**

- A. Refer to Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

#### **3.3 OPERATING AND PERFORMANCE TESTS**

- A. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

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**SECTION 26 05 11**

**REQUIREMENTS FOR ELECTRICAL INSTALLATIONS**

**PART 1-GENERAL**

**1.1 DESCRIPTION**

- A. This Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, applies to all sections of Division 26.
- B. Furnish and install electrical wiring, systems, equipment and accessories in accordance with the specifications and drawings. Capacities and ratings of motors, transformers, cable, switchboards, switchgear, panelboards, motor control centers, and other items and arrangements for the specified items are shown on drawings.
- C. Wiring ampacities specified or shown on the drawings are based on copper conductors, with the conduit and raceways accordingly sized. Aluminum conductors are prohibited.

**1.2 MINIMUM REQUIREMENTS**

- A. References to the National Electrical Code (NEC), Underwriters Laboratories, Inc. (UL) and National Fire Protection Association (NFPA) 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.

**1.3 TEST STANDARDS**

- A. All materials and equipment shall be listed, labeled or certified by a nationally recognized testing laboratory to meet Underwriters Laboratories, Inc., standards where test standards have been established. Equipment and materials which are not covered by UL Standards will be accepted provided equipment and material is listed, labeled, certified or otherwise determined to meet safety requirements of a nationally recognized testing laboratory. Equipment of a class which no nationally recognized testing laboratory accepts, certifies, lists, labels, or determines to be safe, will be considered if inspected or tested in accordance with national industrial standards, such as NEMA, or ANSI. Evidence of compliance shall include certified test reports and definitive shop drawings.

B. Definitions:

1. Listed; equipment or device of a kind mentioned which:
  - a. Is published by a nationally recognized laboratory which makes periodic inspection of production of such equipment.
  - b. States that such equipment meets nationally recognized standards or has been tested and found safe for use in a specified manner.
2. Labeled; equipment or device is when:
  - a. It embodies a valid label, symbol, or other identifying mark of a nationally recognized testing laboratory such as Underwriters Laboratories, Inc.
  - b. The laboratory makes periodic inspections of the production of such equipment.
  - c. The labeling indicates compliance with nationally recognized standards or tests to determine safe use in a specified manner.
3. Certified; equipment or product is which:
  - a. Has been tested and found by a nationally recognized testing laboratory to meet nationally recognized standards or to be safe for use in a specified manner.
  - b. Production of equipment or product is periodically inspected by a nationally recognized testing laboratory.
  - c. Bears a label, tag, or other record of certification.
4. Nationally recognized testing laboratory; laboratory which is approved, in accordance with OSHA regulations, by the Secretary of Labor.

**1.4 QUALIFICATIONS (PRODUCTS AND SERVICES)**

- 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. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within eight hours of receipt of notification that service is needed. Submit name and address of service organizations.

#### **1.5 MANUFACTURED PRODUCTS**

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 Resident Engineer 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 Resident Engineer 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.

#### **1.6 EQUIPMENT REQUIREMENTS**

- A. Where variations from the contract requirements are requested in accordance with 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.

#### **1.7 EQUIPMENT PROTECTION**

- 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 Resident Engineer, 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 kraft 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.

#### **1.8 WORK PERFORMANCE**

- A. All electrical work must comply with the requirements of NFPA 70 (NEC), NFPA 70B, NFPA 70E, OSHA Part 1910 subpart J, OSHA Part 1910 subpart S and OSHA Part 1910 subpart K 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. When an electrical outage cannot be accomplished in this manner for the required work, the following requirements are mandatory:
1. Electricians must use full protective equipment (i.e., certified and tested insulating material to cover exposed energized electrical components, certified and tested insulated tools, etc.) while working on energized systems in accordance with NFPA 70E.
  2. Electricians must wear personal protective equipment while working on energized systems in accordance with NFPA 70E.
  3. Before initiating any work, a job specific work plan must be developed by the contractor with a peer review conducted and documented by the Resident Engineer and Medical Center staff. The work plan must include procedures to be used on and near the live electrical equipment, barriers to be installed, safety equipment to be used and exit pathways.
  4. Work on energized circuits or equipment cannot begin until prior written approval is obtained from the Director of the Medical Center.
- D. For work on existing stations, arrange, phase and perform work to assure electrical service for other buildings at all times. 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 and carefully. 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 interferences. See Section 00 72 00, GENERAL CONDITIONS.

#### **1.9 EQUIPMENT INSTALLATION AND REQUIREMENTS**

- A. Equipment location shall be as close as practical to locations shown on the drawings.
- B. Working spaces shall not be less than specified in the NEC for all voltages specified.
- C. 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.

#### **1.10 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 panelboards, cabinets, motor controllers (starters), safety switches, separately enclosed circuit breakers, individual breakers and controllers in switchboards, switchgear and motor control assemblies, control devices and other significant equipment.
- B. Nameplates shall be laminated black phenolic resin with a white core with engraved lettering, a minimum of 6 mm (1/4 inch) high. Secure nameplates with screws. Nameplates that are furnished by manufacturer as a standard catalog item, or where other method of identification is herein specified, are exceptions.

#### **1.11 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. 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.
- C. 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.
- 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 01 33 23".

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, 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,) associated with equipment or piping so that the proposed installation can be properly reviewed.
  3. Elementary and interconnection wiring diagrams for communication and signal systems, control system and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
  4. Parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.
- F. Manuals: 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. 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 and maintenance instructions.
    - e. Safety precautions.
    - f. Diagrams and illustrations.
    - g. Testing methods.
    - h. Performance data.
    - i. Lubrication schedule including type, grade, temperature range, and frequency.
    - j. 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 parts, and name of servicing organization.
    - k. Appendix; list qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.
- G. Approvals will be based on complete submission of manuals together with shop drawings.
- H. After approval and prior to installation, furnish the Resident Engineer 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 coupling, bushing and termination fitting.
  3. Conduit hangers, clamps and supports.
  4. Duct sealing compound.

5. Each type of receptacle, toggle switch, outlet box, manual motor starter, device plate, engraved nameplate, wire and cable splicing and terminating material and single pole molded case circuit breaker.
6. Each type of light fixture specified in Section 26 51 00, INTERIOR LIGHTING or shown on the drawings.

**1.12 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.

**1.13 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 Resident Engineer at least 30 days prior to the planned training.

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**SECTION 26 05 13**

**MEDIUM-VOLTAGE CABLES**

**PART 1-GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation and connection of the medium voltage cables.

**1.2 RELATED WORK**

- A. Bedding of conduits: Section 31 20 00, EARTH MOVING.
- B. General electrical requirement and items that are common to more than one section of Division 26: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- C. Conduits for high voltage cables: Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
- D. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES and Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Shop Drawings:
1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
  2. Include splice and termination kit information prior to purchase and installation.
  3. Provide cable minimum bend radius, and flammability data.
- C. Samples:
1. After approval and prior to installation, furnish the Resident Engineer with a 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 samples were taken. The sample shall contain the manufacturers' markings.

D. Certifications:

1. Factory test reports: Prior to installation of the cables, deliver four copies of the manufacturers certified NEMA WC 71 or WC 74, standard factory test reports to the Resident Engineer. Certified copies of test data shall show conformance with the referenced standards and shall be approved prior to delivery of cable.
2. Field Test Reports: Test Reports on the following shall be in accordance with the paragraph entitled "Field Tests for High Voltage Cables" and include the following tests:
  - a. High Potential Tests
  - b. Dielectric Absorption Tests
  - c. Radiographic Tests
3. After testing, submit four certified copies of each of the graphs specified under field testing, to the Resident Engineer. Adequate information shall be included identifying the cable locations, types, voltage rating and sizes.
4. Splices and terminations, after having been installed and tested, deliver four copies of a certificate by the Contractor to the Resident Engineer which includes the following:
  - a. A statement that the materials, detail drawings and printed instructions used, are those contained in the kits approved for this contract.
  - b. A statement that each splice and each termination was completely installed without any overnight interruption.
  - c. A statement that field made splices and terminations conform to the following requirements:
    - (1) Pencil the cable insulation precisely.
    - (2) Connector installations:
      - (a) Use tools that are designed for the connectors being installed.
      - (b) Round and smooth the installed connectors to minimize localized voltage stressing of the insulating materials.
    - (3) Remove contaminants from all surfaces within the splices and terminations before installing the insulating materials.
    - (4) Solder block throughout stranded grounding wires that will penetrate the splicing and terminating materials.

- (5) Use mirrors to observe the installation of materials on the backsides of the splices and terminations.
- (6) Eliminate air voids throughout the splices and terminations.
- (7) Stretch each layer of tape properly during installation.

d. List all of the materials purchased and installed for the splices and terminations for this contract including the material descriptions, manufacturer's names, catalog numbers and total quantities.

E. Installer Approval:

1. Employees who install the splices and terminations and test the cables shall have not less than five years of experience splicing and terminating cables which are equal to those being spliced and terminated, including experience with the materials in the kits.
2. Furnish satisfactory proof of such experience for each employee who splices or terminates the cables.

F. Cable Voltage Ratings

1. Medium voltage power cables shall include multiple and single-conductor cable rated as follows:
  - a. 15000 volts shall be used on 12,470, 13,200 and 13,800V 3 phase 60hz distribution systems.

G. Shipment:

1. Cable shall be shipped on reels such that cable will be protected from mechanical injury. Each end of each length of cable shall be hermetically sealed and securely attached to the reel.

**1.4 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 the designation only:

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

- a. B3-2001 Standard Specification for Soft or Annealed Copper Wire

B. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

- a. 386-95 (R2001) Separable Insulated Connector Systems for Power Distribution Systems above 600 V

- b. 400.2-2005 Guide for Field Testing of Shielded Power Cable Systems
- c. 404-2000 Extruded and Laminated Dielectric Shielded Cable Joints  
Rated 2500-500,000 Volts
- C. National Electrical Manufacturers Association (NEMA):
  - a. WC 71-1999 Standard for Non-Shielded Cables Rated 2001-5000 Volts  
for Use in the Distribution of Electrical Energy (ICEA S-96-659)
  - b. WC 74-2000 5-46 KV Shielded Power Cable for Use in the Transmission  
and Distribution of Electrical Energy (ICEA S-93-969)
- D. National Fire Protection Association (NFPA):
  - 1. 70-2005 National Electrical Code (NEC)
- E. Underwriters Laboratories (UL):
  - 1. 1072-2006 Medium-Voltage Power Cables

## **PART 2-PRODUCTS**

### **2.1 MATERIAL MEDIUM VOLTAGE CABLE**

- A. High voltage cable shall be in accordance with the NEC and NEMA WC71, WC74  
and UL 1072.
- B. Shall be single conductor stranded copper conforming to ASTM B3.
- C. Insulation:
  - 1. Insulation level shall be 133 percent.
  - 2. Types of insulation:
    - a. Cable type shall be, EPR: Ethylene propylene rubber insulation shall  
be thermosetting, light and heat stabilized.
    - b. In wet locations, anti-tree CCLP or EPR shall be used.
- D. Conductors and insulation shall be wrapped separately with semiconducting  
tape.
- E. Insulation shall be wrapped with non-magnetic, metallic shielding except  
for cables for series type lighting systems.
- F. Heavy duty, overall protective jackets of chlorosulphonated polyethylene,  
neoprene or polyvinyl chloride shall enclose every cable.

- G. Cable temperature ratings for continuous operation, emergency overload operation and short circuit operation shall be not less than the NEC, NEMA WC71 or NEMA WC74 Standard for the respective cable.
- H. Manufacturer's name and other pertinent information shall be marked or molded clearly on the overall outside surface of the jackets, or incorporated on marker tapes within the cables at reasonable intervals.

## **2.2 MATERIAL, SPLICES AND TERMINATIONS**

- A. The materials shall be compatible with the conductors, insulations and protective jackets on the cables and wires.
- B. The splices shall insulate and protect the conductors not less than the insulation and protective jackets on the cables and wires that protect the conductors. In locations where moisture might be present, the splices shall be watertight. In manholes and handholes the splices shall be submersible.
- C. Splicing and Terminating Fittings: Shall be in accordance with IEEE 386, 404.
  - 1. Shall be heavy duty, pressure type fittings, which will assure satisfactory performance of the connections under conditions of temperature cycling and magnetic forces from available short circuit currents.
  - 2. The fittings shall be suitably designed and the proper size for the cables and wires being spliced and terminated. Terminations to bus shall be with two hole lugs.
  - 3. Where the Government determines that unsatisfactory fittings have been installed, contractor shall replace the unsatisfactory installations with approved fittings at no additional cost to the Government.
- D. Splicing and Terminating Kits:
  - 1. General:
    - a. Shall be assembled by the manufacturer or supplier of the materials and shall be packaged for individual splices and terminations or for groups of splices and terminations.
    - b. Shall consist of materials designed for the cables being spliced and terminated and shall be suitable for the prevailing environmental conditions.



- c. Shall include detail drawings and printed instructions for each type of splice and termination being installed, as prepared by the manufacturers of the materials in the kits.
  - d. Detail drawings, and printed instructions shall indicate the cable type, voltage rating, manufacturer's name and catalog numbers for the materials indicated.
  - e. Voltage ratings for the splices and terminations shall be not less than the voltage ratings for the cables on which they are being installed.
  - f. Shall include shielding and stress cone materials.
2. Taped splices and terminations with insulating and semi-conducting rubber tapes shall withstand 200 percent elongation without cracking, rupturing or reducing their electric and self-bonding characteristics by more than 5 percent.
3. Epoxy resin kits shall be as follows:
    - a. Compatible with the cable insulations and jackets and make the splices watertight and submersible.
    - b. Thermosetting and generate its own heat so that external fire or heat will not be required.
    - c. Set solid and cure in approximately 60 minutes in 21 degree C (70 degree F) ambient temperature.
    - d. Not deteriorate when subjected to oil, water, gases, salt water, sewage and fungus.
    - e. Furnished in pre-measured quantities, sized for each splice and each termination, with two resin components in an easy mixing plastic bag which will permit mixing the resin without entrapping air or contaminants. Other methods of packaging and mixing the epoxy resin components will be considered for approval, provided they include adequate safeguards to assure precise proportioning of the resin components and to prevent entrapping air and contaminants.
    - f. Use snap-together, longitudinally-split, interlocking seam, transplant mold bodies or taped frameworks, injection fittings and injection gun or pouring equipment. Completely fill voids within the splices and terminations.

E. Pre-molded Rubber Splices and Terminations:

1. Splices and terminations shall be in accordance with IEEE 386, and 404.

2. Pre-molded rubber devices shall have a minimum of 3 mm (0.125 inch) semi-conductive shield material covering the entire housing. Test each rubber part prior to shipment from the factory.
3. Grounding of metallic shields shall be accomplished by a solderless connector enclosed in a watertight rubber housing covering the entire assembly. The grounding device and splice or terminator shall be of same manufacturer to insure electrical integrity of the shielded parts.
4. The pre-molded parts shall be suitable for indoor, outdoor, submersible, or direct-burial applications.

### **2.3 MATERIAL, FIREPROOFING TAPE**

- A. The tape shall consist of a flexible, conformable fabric of organic composition coated one side with flame-retardant elastomer.
- B. The tape shall be self-extinguishing and shall not support combustion. It shall be arc proof and fireproof.
- C. The tape shall not deteriorate when subjected to water, gases, salt water, sewage, or fungus. It shall be resistant to sunlight and ultraviolet light.
- D. The finished application shall withstand a 200 ampere arc for not less than 30 seconds.
- E. Securing tape: Shall be glass cloth electrical tape not less than 0.18 mm (7 mils) thick, and 19 mm (3/4 inch) wide.

### **2.4 MATERIAL, WARNING TAPE**

- A. The tape shall be standard, 76 mm (3 inch) wide, 4-Mil polyethylene detectable type with aluminum backing.
- B. The tape shall be red with black letters indicating "CAUTION BURIED ELECTRIC LINE BELOW".

## **PART 3-EXECUTION**

### **3.1 INSTALLATION, MEDIUM VOLTAGE CABLE**

- A. Installation shall be in accordance with the NEC, and as shown on the drawings.
- B. Contractor shall ensure that radii of bends fittings, cable risers, and other conditions are suitable for the cable and conform with the recommendations of the cable manufacturer.

- C. Cable shall be installed in underground duct banks, in conduit above and below grade; inside buildings, on insulator hooks; on racks in wall and ceiling mounted cable trays in utility tunnels and manholes; and by direct burial.
- D. Cables shall be secured with heavy duty cable ties in existing or new trays mounted horizontally, where cable rests on tray bottom.
- E. Cables shall be secured with PVC coated metallic non-metallic cable clamps, straps, hangers, or other approved supporting devices to tunnel walls, ceilings, and in new or existing cable trays mounted vertically, where tray bottom is in a vertical plane.
- F. Contractor shall ensure that all cable tray is properly secured and supported prior to installing new armored cable. Contractor shall add new permanent and/or temporary tray support devices as required to preclude cable tray failure during cable pulling or after cable is installed.
- G. Cable or conductors of a primary distribution system shall be rejected when installed openly in cable trays or openly racked along interior walls; in the same raceway or conduit with AC/DC control circuits or ac power circuits operating at less than 600 volts; or in a manner allowing cable to support its own weight.
- H. Use suitable lubricating compounds on the cables and wires to prevent damage to them during pulling-in. Provide compounds that are not injurious to the cable and wire jackets and do not harden or become adhesive.
- I. Splice the cables and wires only in manholes and accessible junction boxes. Ground shields in accordance with Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- J. In manholes, trenches and vaults install the cables on suitable porcelain insulators with steel cables racks. Ground cable racks in accordance with Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- K. In manholes, underground raceways and other outdoors locations:
  - 1. Seal the cable ends prior to pulling them in to prevent the entry of moisture.
  - 2. For ethylene propylene rubber and polyethylene insulated cables, use bags of epoxy resin that are not less than 6 mm (1/4 inch) larger in

diameter than the overall diameter of the cable. Clean each end of each cable before installing the epoxy resin over it.

### **3.2 PROTECTION DURING SPLICING OPERATIONS**

- A. Blowers shall be provided to force fresh air into manholes or confined areas where free movement or circulation of air is obstructed. Waterproof protective coverings shall be available on the work site to provide protection against moisture while a splice is being made. Pumps shall be used to keep manholes dry during splicing operations. Under no conditions shall a splice or termination be made with the interior of a cable exposed to moisture. Conductor insulation paper shall be moisture-tested before the splice is made. A manhole ring at least 150 mm (6 inches) above ground shall be used around the manhole entrance to keep surface water from entering the manhole. Unused ducts shall be plugged and water seepage through ducts in use shall be stopped before the splice is started.

### **3.3 PULLING CABLES IN DUCTS, MANHOLES AND UTILITY TUNNELS**

- A. Medium-voltage cables shall be pulled into ducts and utility tunnels with equipment designed for this purpose, including power-driven winch, cable-feeding flexible tube guide, cable grips, and lubricants. A sufficient number of trained personnel and equipment shall be employed to ensure the careful and proper installation of the cable.
- B. Cable reel shall be set up at the side of the manhole or tunnel hatch opening and above the duct or hatch level, allowing the cable to enter through the opening without reverse bending. Flexible tube guide shall be installed through the opening in a manner that will prevent the cable from rubbing on the edges of any structural member.
- C. Pulling force for a cable grip on lead-sheathed cable shall not exceed manufacturer's recommendation. A dynamometer shall be used in the pulling line to ensure that the pulling force is not exceeded. Pulling force for a nonmetallic-sheathed cable shall not exceed the smaller of 4400 Newton (1,000 pounds) or a value computed from the following equation:
1.  $T_M = 0.008 \times N \times CM$
  2. Where:  $T_M$  = maximum allowable pulling tension in Newton pounds
  3.  $N$  = number of conductors in the cable

4. CM = cross-sectional area of each conductor in square millimeter circular mils.
- D. Cable shall be unreeled from the top of the reel. Payout shall be carefully controlled. Cable to be pulled shall be attached through a swivel to the main pulling wire by means of a suitable cable grip permitted only on cables less than 60 mm (200-feet) long and less than 50 mm (2 inches) in diameter.
- E. Woven-wire cable grips shall be used to grip the cable end when pulling small cables and short straight lengths of heavier cables.
- F. Pulling eyes shall be attached to the cable conductors to prevent damage to the cable structure.
- G. Pulling eyes and cable grips shall be used together for nonmetallic sheathed cables to prevent damage to the cable structure.
- H. Cables shall be liberally coated with a suitable cable-pulling lubricant as it enters the tube guide or duct. Grease and oil lubricants shall be used only on lead-sheathed cables. Nonmetallic sheathed cables shall be covered with wire-pulling compounds when required which have no deleterious effects on the cable. Rollers, sheaves, or tube guides around which the cable is pulled shall conform to the minimum bending radius of the cable.
- I. Cables shall be pulled into ducts at a reasonable speed not in excess of maximum permissible pulling tension specified by the cable manufacturer. Cable pulling using a vehicle shall not be permitted. Pulling operations shall be stopped immediately with any indication of binding or obstruction and shall not be resumed until such difficulty is corrected. Sufficient slack shall be provided for free movement of cable due to expansion or contraction.
- J. Cable splices made up in manholes or utility tunnels shall be firmly supported on cable racks as indicated. No cable splices shall be pulled in ducts. Cable ends shall overlap at the ends of a section to provide sufficient undamaged cable for splicing. Cables to be spliced in manholes or utility tunnels shall overlap the centerline of the proposed joint by not less than 600 mm (2 feet).
- K. Cables cut in the field shall have the cut ends immediately sealed to prevent entrance of moisture. Nonleaded cables shall be sealed with rubber tape wrapped down to 75 mm (3 inches) from the cable end. Rubber tape shall be

cover-wrapped with polyvinylchloride tape. Lead-Covered cables shall be sealed with wiping metal making a firm bond with the end of the sheath or with a disk of lead fitted over the end and wiped to the sheath.

#### **3.4 INSTALLATION, SPLICES AND TERMINATIONS**

- A. Install the materials as recommended by their manufacturer including special precautions pertaining to air temperature during installation.
- B. Cross-Linked Polyethylene (XLPE), Ethylene Propylene Rubber and Polyethylene Insulated Cables:
  - 1. Cables rated 5000 volts or less: Install epoxy resin splices and terminations, or pre-molded rubber splices and terminations.
  - 2. Cables rated more than 5000 volts: Install taped splices and terminations, or pre-molded rubber splices and terminations.
- C. Installation shall be accomplished by qualified personnel trained to accomplish high voltage equipment installations. All instructions of the manufacturer shall be followed in detail.
- D. Splices shall be made in manholes or tunnels except where cable terminations are specifically indicated. Splicing and terminating of cables shall be expedited to minimize exposure and cable deterioration.
- E. Cables shall be terminated in potheads. Dry terminations with medium voltage pennants, preformed, and hand wrapped stress cones may be used for terminating cables. Potheads shall be provided with adequate means for making external connections to the cable conductors of single or multiple conductor cables; protecting the cable insulation against moisture, oil, or other contaminant; physically protecting and supporting cables, and maintaining the insulation level of the cable.
- F. Pothead terminations shall be field fabricated from termination kits supplied by and in accordance with the pothead manufacturer's recommendations for the type, size, and electrical characteristics of the cable.
- G. Installation shall include built-up or prefabricated heat or cold shrink stress-relief cones at the terminals of all shielded cables and at the terminals of single-conductor lead-covered cables rated 15 kV and above, ungrounded.

- H. Cable splices shall be field fabricated from splicing kits supplied by and in accordance with cable manufacturer's recommendations for the type, size, and electrical characteristics of the cable specified. Cable splices in manholes shall be located midway between cable racks on walls of manholes and supported with cable arms at approximately the same elevation as the enclosing duct.
- I. Cable splices in the tunnel that are not installed in cable trays shall be installed on cable racks or by other approved methods that will minimize physical stress on the splice connections. Splices shall be supported at approximately the same elevation as the installed cable except where space limitations or existing cable length limitations make this method impractical or impossible.
- J. Universal demountable splices shall be supported in such manner so as to minimize physical stress on the splice connections. Each cable end termination shall be supported using a pair of saddle type supports under the cable end termination and/or cable with a minimum 300 mm (12 inches) and a maximum 750 mm (30 inches) separation between the supports. Cable end termination and cable shall be secured to the supports in such a manner as to prevent movement of termination or cable at the support. Saddle type supports shall be installed on galvanized steel framing channel anchored to the wall or securely fastened to the cable tray or installed by other approved methods.

### **3.5 SINGLE-CONDUCTOR POTHEADS**

- A. Single-conductor potheads shall be the hermetically sealed cap-nut type and shall be suitable for the type, size, and electrical characteristics of the cable specified. Potheads shall consist of cast bodies, bushings, cable connectors, lugs, and entrance fittings.
- B. Pothead bodies shall be metal castings with mounting brackets, when required, pipe plugs for filling and vent holes, and machined flanged surface for cable-entrance fitting. Bodies shall be cast iron for cables up to 130 mm<sup>2</sup> (250 kc mils) 250 amperes, and cast aluminum bronze nonmagnetic metal casting for cable of larger size and higher current ratings.
- C. Bushings shall be glazed wet-process electrical porcelain insulators, factory assembled and hermetically sealed to the pothead body.

D. Cable connectors shall be high-conductivity copper accurately machined and threaded for internal and external electrical connections.

Cross-sectional and contact areas shall be adequate to carry the full-load current rating of the conductors. Cable connectors shall be solder type with gasket seal between the connector and bushing.

E. Potheads shall be completely filled, leaving no gaps or voids, with an insulating compound suitable for the type of cable, insulation, voltage rating, and ambient operating temperatures in accordance with the pothead manufacturer's recommendations. Pothead parts that do not carry current shall be grounded.

### **3.6 INSTALLATION, FIREPROOFING**

A. Cover all power cables located in manholes, handholes and junction boxes with arc proof and fireproof tape.

B. Apply the tape in a single layer, one-half lapped or as recommended by the manufacturer. Install the tape with the coated side towards the cable and extend it not less than 25 mm (one inch) into each duct.

C. Secure the tape in place by a random wrap of glass cloth tape.

### **3.7 FEEDER IDENTIFICATION**

A. In each manhole and pullbox install permanent tags on each circuit's cables and wires to clearly designate their circuit identification and voltage. In manholes the tags shall be the embossed brass type and shall also show the cable type and voltage rating. Position the tags so they will be easy to read after the fireproofing is installed.

### **3.8 FIELD TESTS FOR HIGH VOLTAGE CABLE**

A. New Cable:

1. Acceptance tests shall be performed on new and service aged PE XLPE, PVC and paper cables in accordance with IEEE 400.2 and as specified herein.

2. Test new cable after installation, splices, and terminations have been made, but before connection to equipment and existing cable.

3. Test equipment, labor and technical personnel shall be provided as necessary to perform the electrical acceptance tests. Arranges shall be made to have tests witnessed by the Resident Engineer.



B. Service Age Cable:

1. Maintenance tests shall be performed on service-aged cable interconnected to new cable. See test voltages below.
2. After new cable test and connection to an existing cable, test the interconnected cable. Disconnect cable from all equipment that might be damaged by the test voltages.

C. Dielectric Absorption Test: Both new and service aged power cable shall be completely isolated from extraneous electrical connections at cable terminations and joints. Safety precautions shall be observed. Each cable shall be given a full dielectric - absorption test with a 5000v insulation resistance test set. Test shall be applied for a long enough time to charge the cable. Readings shall be recorded every 15 seconds during the first 3 minutes of test and at 1 minute intervals thereafter. Test shall continue until three equal readings 1 minute apart are obtained. Minimum readings shall be 200 megohms at an ambient temperature 20 degrees C (68 degrees F). Readings taken at other temperatures shall be corrected accordingly.

D. High Potential Test: High potential test shall not be applied to the XLPE new or service aged cables. All other cables shall be subjected to the test but only upon successful dielectric absorption test.

1. Leakage current test shall be by high potential dc step voltage method.
2. High potential test shall measure the leakage current from each conductor to the insulation shield. Use corona shields, guard rings, taping, mason jars, or plastic bags to prevent corona current from influencing the readings. Unprepared cable shield ends shall be trimmed back 25 mm (1 inch) or more for each 10 kV of test voltage. Upon the successful completion of the high potential test on new and service aged PE CCLP, PC PVC cables a second dielectric test will be run on the HV cable system to ensure the cables have not been damaged by the hi-pot test

E. Safety Precautions:

1. Exercise suitable and adequate safety measures prior to, during, and after the high potential tests, including placing warning signs and preventing people and equipment from being exposed to the test voltages.

F. Test Voltages:

1. New shielded EPR and CCLP cable dc test voltages shall be as follows:

Rated Circuit Voltage Phase-to-Phase Volt	Wire Size AWG or MCM	Test Voltage KV
2001-5000	8-1000	25
5001-8000	6-1000	35
8001-15000	2-1000	65
15001-25001	1-1000	100
25001-28000	1-1000	-
28001-35000	1/0-1000	-

2. Existing cable of all types interconnected to a new cable shall be tested at 1.7 times the existing cable rated voltage (maintenance test).

G. High Potential Test Method:

1. Apply voltage in approximately 8 to 10 equal steps.
2. Raise the voltage slowly between steps.
3. At the end of each step, allow the charging currents to decay, and time the interval of decay.
4. Read the leakage current and plot a curve of leakage currents versus test voltage on graph paper as the test progresses. Read the leakage current at the same time interval for each voltage step.
5. Stop the test if leakage currents increase excessively or a "knee" appears in the curve before maximum test voltage is reached.
  - a. For new cable, repair or replace the cable and repeat the test.
  - b. For existing cable interconnected to new cable, notify the Resident Engineer for further instructions.
6. Upon reaching maximum test voltage, hold the voltage for five minutes. Read the leakage current at 30 second intervals and plot a curve of leakage current versus time on the same graph paper as the step voltage curve. Stop the test if leakage current starts to rise, or decreases and again starts to rise. Leakage current should decrease and stabilize for good cable.
7. Terminate test and allow sufficient discharge time before testing the next conductor.

- H. Test Data: Test data shall be recorded and shall include identification of cable and location, megohm readings versus time, leakage current readings versus time, and cable temperature versus time.
- I. Final Acceptance: Final acceptance shall depend upon the satisfactory performance of the cable under test. No cable shall be energized until recorded test data have been approved by the Resident Engineer. Final test reports shall be provided to the Resident Engineer. Reports shall have a cover letter/sheet clearly marked with the System name, Date, and the words "Final Test Report" Forward to the Resident Engineer for inclusion in the Maintenance Database.
- J. Radiographic Tests: Radiographic tests shall be performed on all potheads at the discretion of the Resident Engineer to determine if voids exist in the pothead. Unacceptable terminations shall be reworked at no additional expense to the Government.
- K. Series Outdoor Lighting Cables: Test the series outdoor lighting system cables by standard megger methods in lieu of testing by high potential methods.
- L. The contractor shall furnish the instruments, materials and labor for these tests.

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**SECTION 26 05 21**

**LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW)**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation, and connection of the low voltage power and lighting wiring.

**1.2 RELATED WORK**

- A. Excavation and backfill for cables that are installed in conduit: Section 31 20 00, EARTH MOVING.
- B. Sealing around penetrations to maintain the integrity of time rated construction: Section 07 84 00, FIRESTOPPING.
- C. General electrical requirements that are common to more than one section in Division 26: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- D. Conduits for cables and wiring: Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
- E. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

**1.3 SUBMITTALS**

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
1. Manufacturer's Literature and Data: Showing each cable type and rating.
  2. Certificates: Two weeks prior to final inspection, deliver to the Resident Engineer four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.

**1.4 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 the basic designation only.

- B. American Society of Testing Material (ASTM):
  - 1. D2301-04 Standard Specification for Vinyl Chloride Plastic Pressure Sensitive Electrical Insulating Tape
- C. Federal Specifications (Fed. Spec.):
  - 1. A-A-59544-00 Cable and Wire, Electrical (Power, Fixed Installation)
- D. National Fire Protection Association (NFPA):
  - 1. 70-05 National Electrical Code (NEC)
- E. Underwriters Laboratories, Inc. (UL):
  - 1. 44-02 Thermoset-Insulated Wires and Cables
  - 2. 83-03 Thermoplastic-Insulated Wires and Cables
  - 3. 467-01 Electrical Grounding and Bonding Equipment
  - 4. 486A-01 Wire Connectors and Soldering Lugs for Use with Copper Conductors
  - 5. 486C-02 Splicing Wire Connectors
  - 6. 486D-02 Insulated Wire Connector Systems for Underground Use or in Damp or Wet Locations
  - 7. 486E-00 Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
  - 8. 493-01 Thermoplastic-Insulated Underground Feeder and Branch Circuit Cable
  - 9. 514B-02 Fittings for Cable and Conduit
  - 10. 1479-03 Fire Tests of Through-Penetration Fire Stops

## **PART 2 - PRODUCTS**

### **2.1 CABLE AND WIRE (POWER AND LIGHTING)**

- A. Cable and Wire shall be in accordance with Fed. Spec. A-A-59544, except as hereinafter specified.
- B. Single Conductor:
  - 1. Shall be annealed copper.
  - 2. Shall be stranded for sizes No. 8 AWG and larger, solid for sizes No. 10 AWG and smaller.
  - 3. Shall be minimum size No. 12 AWG, except where smaller sizes are allowed herein.
- C. Insulation:
  - 1. THW, XHHW, or dual rated THHN-THWN shall be in accordance with UL 44, and 83.

2. Direct burial: UF or USE shall be in accordance with UL 493.
3. Isolated power system wiring: Type XHHW with a dielectric constant of 3.5 or less.

D. Color Code:

1. Secondary service, feeder and branch circuit conductors shall be color coded as follows:

208/120 volt	Phase	480/277 volt
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray *
* or white with colored (other than green) tracer.		

- a. The lighting circuit "switch legs" and 3-way switch "traveling wires" shall have color coding unique and distinct (i.e. pink and purple) from the color coding indicated above. The unique color codes shall be solid and in accordance with the NEC. Field coordinate for a final color coding with the Resident Engineer.
2. Use solid color compound or solid color coating for No. 12 AWG and No. 10 AWG branch circuit conductors and neutral sizes.
3. Phase conductors No. 8 AWG and larger shall be color-coded using one of the following methods:
  - b. Solid color compound or solid color coating.
  - c. Stripes, bands, or hash marks of color specified above.
  - d. Color as specified using 19 mm (3/4 inch) wide tape. Apply tape in half overlapping turns for a minimum of 75 mm (three inches) for terminal points, and in junction boxes, pull boxes, troughs, manholes, and handholes. 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.
4. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.
5. Color code for isolated power system wiring shall be in accordance with the NEC.

## 2.2 SPLICES AND JOINTS

- A. In accordance with UL 486A, C, D, E and NEC.
- B. Branch circuits (No. 10 AWG and smaller):
  1. Connectors: Solderless, screw-on, reusable pressure cable type, 600 volt, 105 degree C with integral insulation, approved for copper.

2. The integral insulator shall have a skirt to completely cover the stripped wires.
3. The number, size, and combination of conductors, as listed on the manufacturers packaging shall be strictly complied with.

C. Feeder Circuits:

1. Connectors shall be indent, hex screw, or bolt clamp-type of high conductivity and corrosion-resistant material.
2. Field installed compression connectors for cable sizes 250 kcmil and larger shall have not less than two clamping elements or compression indents per wire.
3. Insulate splices and joints with materials approved for the particular use, location, voltage, and temperature. Insulate with not less than that of the conductor level that is being joined.
4. Plastic electrical insulating tape: ASTM D2304 shall apply, flame retardant, cold and weather resistant.

**2.3 CONTROL WIRING**

- A. Unless otherwise specified in other sections of these specifications, control wiring shall be as specified for power and lighting wiring, except the minimum size shall be not less than No. 14 AWG.
- B. Control wiring shall be large enough so that the voltage drop under inrush conditions does not adversely affect operation of the controls.

**2.4 WIRE LUBRICATING COMPOUND**

- A. Suitable for the wire insulation and conduit it is used with, and shall not harden or become adhesive.
- B. Shall not be used on wire for isolated type electrical power systems.

**2.5 FIREPROOFING TAPE**

- A. The tape shall consist of a flexible, conformable fabric of organic composition coated one side with flame-retardant elastomer.
- B. The tape shall be self-extinguishing and shall not support combustion. It shall be arc-proof and fireproof.
- C. The tape shall not deteriorate when subjected to water, gases, salt water, sewage, or fungus and be resistant to sunlight and ultraviolet light.
- D. The finished application shall withstand a 200-ampere arc for not less than 30 seconds.
- E. Securing tape: Glass cloth electrical tape not less than 0.18 mm (7 mils) thick, and 19 mm (3/4 inch) wide.

## 2.6 WARNING TAPE

- A. The tape shall be standard, 76 mm (3 inch) wide, 4-Mil polyethylene detectable type.
- B. The tape shall be red with black letters indicating "CAUTION BURIED ELECTRIC LINE BELOW".

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Install in accordance with the NEC, and as specified.
- B. Install all wiring in raceway systems.
- C. Splice cables and wires only in outlet boxes, junction boxes, pull boxes, manholes, or handholes.
- D. Wires of different systems (i.e. 120V, 277V) shall not be installed in the same conduit or junction box system.
- 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. For panelboards, cabinets, wireways, switches, and equipment assemblies, neatly form, train, and tie the cables in individual circuits.
- G. Seal cable and wire entering a building from underground, between the wire and conduit where the cable exits the conduit, with a non-hardening approved compound.
- H. Wire Pulling:
  - 1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables.
  - 2. Use ropes made of nonmetallic material for pulling feeders.
  - 3. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors, as approved by the Resident Engineer.
  - 4. Pull in multiple cables together in a single conduit.
- I. No more than (3) single-phase branch circuits shall be installed in any one conduit.
- J. The wires shall be derated in accordance with NEC Article 310. Neutral wires, under conditions defined by the NEC, shall be considered current-carrying conductors.



### **3.2 INSTALLATION IN MANHOLES**

- A. Install and support cables in manholes on the steel racks with porcelain or equal insulators. 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 where low voltage cables are installed in the same manholes with high voltage cables; also cover the low voltage cables with arc proof and fireproof tape.
  - 2. Use tape of the same type as used for the high voltage cables, and apply the tape in a single layer, one-half lapped or as recommended by the manufacturer. Install the tape with the coated side towards the cable and extend it not less than 25 mm (one inch) into each duct.
  - 3. Secure the tape in place by a random wrap of glass cloth tape.

### **3.3 SPLICE INSTALLATION**

- A. Splices and terminations shall be mechanically and electrically secure.
- B. Where the Government determines that unsatisfactory splices or terminations have been installed, remove the devices and install approved devices at no additional cost to the Government.

### **3.4 CONTROL AND SIGNAL WIRING INSTALLATION**

- A. Unless otherwise specified in other sections install wiring and connect to equipment/devices to perform the required functions as shown and specified.
- B. Except where otherwise required, install a separate power supply circuit for each system so that malfunctions in any system will not affect other systems.
- C. Where separate power supply circuits are not shown, connect the systems to the nearest panelboards of suitable voltages, which are intended to supply such systems and have suitable spare circuit breakers or space for installation.
- D. Install a red warning indicator on the handle of the branch circuit breaker for the power supply circuit for each system to prevent accidental de-energizing of the systems.
- E. System voltages shall be 120 volts or lower where shown on the drawings or as required by the NEC.

### **3.5 CONTROL AND SIGNAL SYSTEM 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.

**3.6 FEEDER IDENTIFICATION**

- A. In each interior pulbox and junction box, install metal tags on each circuit cables and wires to clearly designate their circuit identification and voltage.
- B. In each manhole and handhole, provide tags of the embossed brass type, showing the cable type and voltage rating. Attach the tags to the cables with slip-free plastic cable lacing units.

**3.7 exisitng wiring**

- A. Unless specifically indicated on the plans, existing wiring shall not be reused for the new installation. Only wiring that conforms to the specifications and applicable codes may be reused. If existing wiring does not meet these requirements, existing wiring may not be reused and new wires shall be installed.

**3.8 FIELD TESTING**

- A. Feeders and branch circuits shall have their insulation tested after installation and before connection to utilization devices such as fixtures, motors, or appliances.
- B. Tests shall be performed by megger and conductors shall test free from short-circuits and grounds.
- C. Test conductor phase-to-phase and phase-to-ground.
- D. The Contractor shall furnish the instruments, materials, and labor for these tests.

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**SECTION 26 05 26**

**GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies general grounding and bonding requirements of electrical equipment operations and to provide a low impedance path for possible ground fault currents.
- B. "Grounding electrode system" refers to all electrodes required by NEC, as well as including made, supplementary, lightning protection system grounding electrodes.
- C. The terms "connect" and "bond" are used interchangeably in this specification and have the same meaning.

**1.2 RELATED WORK**

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.
- B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Low Voltage power and lighting wiring.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Shop Drawings:
  - 1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
  - 2. Include the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.
- C. Test Reports: Provide certified test reports of ground resistance.
- D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the Resident Engineer:
  - 1. Certification that the materials and installation is in accordance with the drawings and specifications.
  - 2. Certification, by the Contractor, that the complete installation has been properly installed and tested.

#### 1.4 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 the basic designation only.
- B. American Society for Testing and Materials (ASTM):
  - 1. B1-2001 Standard Specification for Hard-Drawn Copper Wire
  - 2. B8-2004 Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- C. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
  - 1. 81-1983 IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
- D. National Fire Protection Association (NFPA):
  - 1. 70-2005 National Electrical Code (NEC)
  - 2. 99-2005 Health Care Facilities
- E. Underwriters Laboratories, Inc. (UL):
  - 1. 44-2005 Thermoset-Insulated Wires and Cables
  - 2. 83-2003 Thermoplastic-Insulated Wires and Cables
  - 3. 467-2004 Grounding and Bonding Equipment
  - 4. 486A-486B-2003 Wire Connectors

## PART 2 - PRODUCTS

### 2.1 GROUNDING AND BONDING CONDUCTORS

- A. Equipment grounding conductors shall be UL 83 insulated stranded copper, except that sizes 6 mm<sup>2</sup> (10 AWG) and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes 25 mm<sup>2</sup> (4 AWG) and larger shall be permitted to be identified per NEC.
- B. Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes 6 mm<sup>2</sup> (10 AWG) and smaller shall be ASTM B1 solid bare copper wire.
- C. Isolated Power System: Type XHHW-2 insulation with a dielectric constant of 3.5 or less.
- D. Electrical System Grounding: Conductor sizes shall not be less than what is shown on the drawings and not less than required by the NEC, whichever is greater.

## **2.2 GROUND RODS**

- A. Copper clad steel, 19 mm (3/4-inch) diameter by 3000 mm (10 feet) long, conforming to UL 467.
- B. Quantity of rods shall be as required to obtain the specified ground resistance.

## **2.3 SPLICES AND TERMINATION COMPONENTS**

- A. Components shall meet or exceed UL 467 and be clearly marked with the manufacturer, catalog number, and permitted conductor size(s).

## **2.4 GROUND CONNECTIONS**

- A. Below Grade: Exothermic-welded type connectors.
- B. Above Grade:
  - 1. Bonding Jumpers: compression type connectors, using zinc-plated fasteners and external tooth lockwashers.
  - 2. Ground Busbars: Two-hole compression type lugs using tin-plated copper or copper alloy bolts and nuts.
  - 3. Rack and Cabinet Ground Bars: one-hole compression-type lugs using zinc-plated or copper alloy fasteners.

## **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 with minimum dimensions of 4 mm thick by 19 mm wide (3/8 inch x 3/4 inch).

## **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 screw lug-type terminal blocks.

## **2.7 SPLICE CASE GROUND ACCESSORIES**

- A. Splice case grounding and bonding accessories shall be supplied by the splice case manufacturer when available. Otherwise, use 16 mm<sup>2</sup> (6 AWG) insulated ground wire with shield bonding connectors.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. Ground in accordance with the NEC, as shown on drawings, and as hereinafter specified.

- B. System Grounding:
  - 1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformers.
  - 2. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.
- C. Equipment Grounding: Metallic structures (including ductwork and building steel), 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. Special Grounding: 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 buried or otherwise normally inaccessible (except connections for which periodic testing access is required) by exothermic weld.

### 3.3 MEDIUM-VOLTAGE EQUIPMENT AND CIRCUITS

- A. Duct Banks and Manholes: Provide an insulated equipment grounding conductor in each duct containing medium or high voltage conductors, sized per NEC except that minimum size shall be 25 mm<sup>2</sup> (2 AWG). Bond the equipment grounding conductors to the switchgear ground bus, to all manhole hardware and ground rods, to the cable shielding grounding provisions of medium or high voltage cable splices and terminations, and equipment enclosures.
- B. Pad Mounted Transformers:
  - 1. Provide a driven ground rod and bond with a grounding electrode conductor to the transformer grounding pad metal steel.
  - 2. Ground the secondary neutral.
- C. Lightning Arresters: Connect lightning arresters to the equipment ground bus or ground rods as applicable.
- D. Metallic Conduit: 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 bare grounding conductor to the equipment ground bus.

### 3.4 SECONDARY EQUIPMENT AND CIRCUITS

- A. Main Bonding Jumper: Bond the secondary service neutral to the ground bus in the service equipment.
- B. Metallic Piping, Building Steel, and Supplemental Electrode(s):
  - 1. Provide a grounding electrode conductor sized per NEC between the service equipment ground bus and all metallic water and gas pipe systems, building steel, and supplemental or made electrodes. Jumper insulating joints in the metallic piping. All connections to

- electrodes shall be made with fittings that conform to UL 467.
2. Provide a supplemental ground electrode and bond to the grounding electrode system.
- C. Service Disconnect (Separate Individual Enclosure): Provide a ground bar bolted to the enclosure with lugs for connecting the various grounding conductors.
- D. Switchgear, Switchboards, Unit Substations, and Motor Control Centers:
1. Connect the various feeder equipment grounding conductors to the ground bus in the enclosure with suitable pressure connectors.
  2. For service entrance equipment, connect the grounding electrode conductor to the ground bus.
  3. Connect metallic conduits, which terminate without mechanical connection to the housing, by grounding bushings and grounding conductor to the equipment ground bus.
- E. 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.
- F. Conduit Systems:
1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
  2. Non-metallic conduit systems shall contain an equipment grounding conductor, except that non-metallic feeder conduits which carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment need not contain an equipment grounding conductor.
  3. Conduit containing only a grounding conductor, and which is provided for mechanical protection of the conductor, shall be bonded to that conductor at the entrance and exit from the conduit.
- G. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders and power and lighting branch circuits.
- H. 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.



3. Provide ground bars in panelboards, bolted to the housing, with sufficient lugs to terminate the equipment grounding conductors.

- I. Motors and Starters: Provide lugs in motor terminal box and starter housing or motor control center compartment to terminate equipment grounding conductors.
- J. Receptacles shall not be grounded through their mounting screws. Ground with a jumper from the receptacle green ground terminal to the device box ground screw and the branch circuit equipment grounding conductor.
- K. Ground lighting fixtures to the equipment grounding conductor of the wiring system when the green ground is provided; otherwise, ground the fixtures through the conduit systems. 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.
- L. Fixed electrical appliances and equipment shall be provided with a ground lug for termination of the equipment grounding conductor.
- M. Panelboard Bonding: The equipment grounding terminal buses of the normal and essential branch circuit panelboards serving the same individual patient vicinity shall be bonded together with an insulated continuous copper conductor not less than 16 mm<sup>2</sup> (10 AWG). These conductors shall be installed in rigid metal conduit.

### **3.5 CORROSION INHIBITORS**

- A. When making ground and ground 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 building 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 gases and suction piping, at the outlets, directly to the room or patient ground bus.

### **3.7 ELECTRICAL ROOM GROUNDING**

- A. Building Earth Ground Busbars: Provide ground busbar hardware at each electrical room and connect to pigtail extensions of the building grounding ring.

### **3.8 WIREWAY GROUNDING**

- A. Ground and Bond Metallic Wireway Systems as follows:
- B. Bond the metallic structures of wireway to provide 100 percent electrical continuity throughout the wireway system by connecting a 16 mm<sup>2</sup> (6 AWG)

bonding jumper at all intermediate metallic enclosures and across all section junctions.

- C. Install insulated 16 mm<sup>2</sup> (6 AWG) bonding jumpers between the wireway system bonded as required in paragraph 1 above, and the closest building ground at each end and approximately every 16 meters (50 feet).
- D. Use insulated 16 mm<sup>2</sup> (6 AWG) bonding jumpers to ground or bond metallic wireway at each end at all intermediate metallic enclosures and cross all section junctions.
- E. Use insulated 16 mm<sup>2</sup> (6 AWG) bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 15 meters.

### 3.9 GROUND RESISTANCE

- A. Grounding system resistance to ground shall not exceed 5 ohms. Make necessary modifications or additions to the grounding electrode system for compliance without additional cost to the Government. Final tests shall assure that this requirement is met.
- B. 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 and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. 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. Services at power company interface points shall comply with the power company ground resistance requirements.
- D. Below-grade connections shall be visually inspected by the Resident Engineer prior to backfilling. The Contractor shall notify the Resident Engineer 24 hours before the connections are ready for inspection.

### 3.10 GROUND ROD INSTALLATION

- A. Drive each rod vertically in the earth, not less than 3000 mm (10 feet) in depth.
- B. Where 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.
- C. Where rock prevents the driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve the specified resistance.

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**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. Bedding of conduits: Section 31 20 00, EARTH MOVING.
- B. Mounting board for telephone closets: Section 06 10 00, ROUGH CARPENTRY.
- C. Sealing around penetrations to maintain the integrity of fire rated construction: Section 07 84 00, FIRESTOPPING.
- D. Fabrications for the deflection of water away from the building envelope at penetrations: Section 07 60 00, FLASHING AND SHEET METAL.
- E. Sealing around conduit penetrations through the building envelope to prevent moisture migration into the building: Section 07 92 00, JOINT SEALANTS.
- F. Identification and painting of conduit and other devices: Section 09 91 00, PAINTING.
- G. General electrical requirements and items that is common to more than one section of Division 26: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- H. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

**1.3 SUBMITTALS**

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
- B. Shop Drawings:
  - 1. Size and location of main feeders;
  - 2. Size and location of panels and pull boxes

3. Layout of required conduit penetrations through structural elements.
4. The specific item proposed and its area of application shall be identified on the catalog cuts.

C. Certification: Prior to final inspection, deliver to the Resident Engineer four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.

#### 1.4 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 the basic designation only.
- B. National Fire Protection Association (NFPA):
1. 70-05 National Electrical Code (NEC)
- C. Underwriters Laboratories, Inc. (UL):
1. 1-03 Flexible Metal Conduit
  2. 5-01 Surface Metal Raceway and Fittings
  3. 6-03 Rigid Metal Conduit
  4. 50-03 Enclosures for Electrical Equipment
  5. 360-03 Liquid-Tight Flexible Steel Conduit
  6. 467-01 Grounding and Bonding Equipment
  7. 514A-01 Metallic Outlet Boxes
  8. 514B-02 Fittings for Cable and Conduit
  9. 514C-05 Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers
  10. 651-02 Schedule 40 and 80 Rigid PVC Conduit
  11. 651A-03 Type EB and A Rigid PVC Conduit and HDPE Conduit
  12. 797-03 Electrical Metallic Tubing
  13. 1242-00 Intermediate Metal Conduit
- D. National Electrical Manufacturers Association (NEMA):
1. TC-3-04 PVC Fittings for Use with Rigid PVC Conduit and Tubing
  2. FB1-03 Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable

## PART 2 - PRODUCTS

### 2.1 MATERIAL

- A. Conduit Size: In accordance with the NEC, but not less than 13 mm (1/2 inch) unless otherwise shown. Where permitted by the NEC, 13 mm (1/2 inch)

flexible conduit may be used for tap connections to recessed lighting fixtures.

B. Conduit:

1. Rigid galvanized steel: Shall Conform to UL 6, ANSI C80.1.
2. Rigid aluminum: Shall Conform to UL 6A, ANSI C80.5.
3. Rigid intermediate steel conduit (IMC): Shall Conform to UL 1242, ANSI C80.6.
4. Electrical metallic tubing (EMT): Shall Conform to UL 797, ANSI C80.3. Maximum size not to exceed 105 mm (4 inch) and shall be permitted only with cable rated 600 volts or less.
5. Flexible galvanized steel 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 IMC conduit fittings:
  - a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
  - b. Standard threaded couplings, locknuts, bushings, 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. 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 prohibited.
  - 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. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
  - b. Only steel or malleable iron materials are acceptable.
  - c. Couplings and connectors: Concrete tight and rain tight, with connectors having insulated throats. Use gland and ring compression type couplings and connectors for conduit sizes 50 mm (2 inches) and smaller. Use set screw type couplings with four set screws each for conduit sizes over 50 mm (2 inches). Use set screws of case-hardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.
  - d. Indent type connectors or couplings are prohibited.
  - e. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.
- 4. Flexible steel conduit fittings:
  - a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
  - b. Clamp type, with insulated throat.
- 5. Liquid-tight flexible metal conduit fittings:
  - a. Fittings shall meet the requirements of UL 514B and ANSI/ 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.
- 6. Direct burial plastic conduit fittings:
  - a. Fittings shall meet the requirements of UL 514C and NEMA TC3.
  - b. As recommended by the conduit manufacturer.
- 7. Surface metal raceway fittings: As recommended by the raceway manufacturer.
- 8. Expansion and deflection couplings:
  - a. Conform to UL 467 and UL 514B.
  - b. Accommodate, 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 fault currents in accordance with UL 467, and the NEC code tables for ground 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 by 38 mm (1-1/2 by 1-1/2 inch), 12 gage steel, cold formed, lipped channels; with not less than 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, Junction, and Pull Boxes:
1. UL-50 and UL-514A.
  2. Cast metal where required by the NEC or shown, and equipped with rustproof boxes.
  3. Sheet metal boxes: Galvanized steel, except where otherwise shown.
  4. Flush mounted wall or ceiling boxes shall be installed with raised covers so that 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.
- 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 ELECTRIC LINE BELOW".

### **PART 3 - EXECUTION**

#### **3.1 PENETRATIONS**

- A. Cutting or Holes:
1. Locate holes in advance where they are proposed in the structural sections such as ribs or beams. Obtain the approval of the Resident Engineer prior to drilling through structural sections.
  2. Cut 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 allowed, except where permitted by the Resident Engineer as required by limited working space.
- B. Fire Stop: 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, with rock wool fiber or silicone foam sealant only. Completely fill and seal clearances between raceways and openings with the fire stop material.
- C. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal clearances around the conduit and make watertight as specified in Section 07 92 00, JOINT SEALANTS.



### 3.2 INSTALLATION, GENERAL

- A. In accordance with UL, NEC, as shown, and as hereinafter specified.
- B. Essential (Emergency) raceway systems shall be entirely independent of other raceway systems, except where specifically "accepted" by NEC Article 517.
- C. Install conduit as follows:
  - 1. In complete runs before pulling in cables or wires.
  - 2. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new undamaged material.
  - 3. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
  - 4. Cut square with a hacksaw, ream, remove burrs, and draw up tight.
  - 5. Mechanically and electrically continuous.
  - 6. Independently support conduit at 8'0" on center. Do not use other supports i.e., (suspended ceilings, suspended ceiling supporting members, lighting fixtures, conduits, mechanical piping, or mechanical ducts).
  - 7. Support within 300 mm (1 foot) of changes of direction, and within 300 mm (1 foot) of each enclosure to which connected.
  - 8. Close ends of empty conduit with plugs or caps at the rough-in stage to prevent entry of debris, until wires are pulled in.
  - 9. Conduit installations under fume and vent hoods are prohibited.
  - 10. Secure conduits to cabinets, junction boxes, pull boxes and outlet boxes with bonding type locknuts. For rigid 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.
  - 11. Flashing of penetrations of the roof membrane is specified in Section 07 60 00, FLASHING AND SHEET METAL.
  - 12. Do not use aluminum conduits in wet locations.
  - 13. Unless otherwise indicated on the drawings or specified herein, all conduits shall be installed concealed within finished walls, floors and ceilings.
- 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.

2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted approved by the Resident Engineer .

### 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 when the following occurs:
  - a. Where shown on the structural drawings.
  - b. As approved by the Resident Engineer 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 1/3 of the slab thickness is prohibited.
  - b. Space between conduits in slabs: Approximately six conduit diameters apart, except 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 (3/4 inch) of concrete around the conduits.
5. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to insure low resistance ground continuity through the conduits. Tightening set screws with pliers is prohibited.

#### B. Furred or Suspended Ceilings and in Walls:

1. Conduit for conductors above 600 volts:
  - a. Rigid steel or rigid aluminum.
  - b. Aluminum conduit mixed indiscriminately with other types in the same system is prohibited.
2. Conduit for conductors 600 volts and below:
  - a. Rigid steel, IMC, rigid aluminum, or EMT. Different type conduits mixed indiscriminately 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 1800 mm (six feet) of flexible metal conduit extending from a junction box to the fixture.
5. Tightening set screws with pliers is prohibited.

### 3.4 EXPOSED WORK INSTALLATION

- A. Unless otherwise indicated on the drawings, exposed conduit is only

permitted in mechanical and electrical rooms.

- B. Conduit for conductors above 600 volts:
  - 1. Rigid steel or rigid aluminum.
  - 2. Aluminum conduit mixed indiscriminately with other types in the same system is prohibited.
- C. Conduit for Conductors 600 volts and below:
  - 1. Rigid steel, IMC, rigid aluminum, or EMT. Different type of conduits mixed indiscriminately 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 2400 mm (eight foot) intervals.
- G. Surface metal raceways: Use only where shown.
- H. Painting:
  - 1. Paint exposed conduit as specified in Section 09 91 00, PAINTING.
  - 2. Paint all conduits containing cables rated over 600 volts safety orange. Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color. In addition, paint legends, using 50 mm (two inch) high black numerals and letters, showing the cable voltage rating. Provide legends where conduits pass through walls and floors and at maximum 6000 mm (20 foot) intervals in between.

### 3.5 DIRECT BURIAL INSTALLATION

- A. Exterior routing of Lighting Systems and Other Branch circuits (600 Volt and Less, and 1500 mm (5 feet) from the buildings):
  - 1. Conduit: Thick wall PVC or high density PE, unless otherwise shown.
  - 2. Mark conduit at uniform intervals to show the kind of material, direct burial type, and the UL approval label.
  - 3. Install conduit fittings and terminations as recommended by the conduit manufacturer.
  - 4. Tops of conduits shall be as follows unless otherwise shown:
    - a. Not less than 600 mm (24 inches) below finished grade.
    - b. Not less than 750 mm (30 inches) below road and other paved surfaces.
  - 5. Work with extreme care near existing ducts, conduits, cables, and other utilities to avoid damaging them.
  - 6. Excavation for conduit bedding and back-filling of trenches is specified in Section 31 20 00, EARTH MOVING.
    - a. Cut the trenches neatly and uniformly.

- b. Do not kink the conduits.
- 7. Seal conduits, including spare conduits, at building entrances and at outdoor terminations for equipment with a suitable compound that prevents the entrance of moisture and gases.
- 8. Where metal conduit is shown, install threaded heavy wall rigid steel galvanized conduit or type A20 rigid steel galvanized conduit coated with .5 mm (20 mil) bonded PVC, or rigid steel or IMC, PVC coated or standard coated with bituminous asphaltic compound.
- 9. Warning tape shall be continuously placed 300 mm (12 inches) above conduits or electric lines.

B. Exterior routing of lighting systems and other branch circuits (600 volts and less-under buildings slab on grade to 1500 mm (5 feet) from the building):

- 1. Pre-coated rigid galvanized steel conduit in accordance with the requirements of Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION.

### 3.6 HAZARDOUS LOCATIONS

- A. Use rigid steel conduit only, notwithstanding requirements otherwise specified in this or other sections of these specifications.
- B. Install UL approved sealing fittings, that prevent passage of explosive vapors, in hazardous areas equipped with explosive proof lighting fixtures, switches, and receptacles, as required by the NEC.

### 3.7 WET OR DAMP LOCATIONS

- A. Unless otherwise shown, use conduits of rigid steel or IMC.
- 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. Unless otherwise shown, use rigid steel or IMC conduit within 1500 mm (5 feet) of the exterior and below concrete building slabs in contact with soil, gravel, or vapor barriers. Conduit shall include an outer factory coating of .5 mm (20 mil) bonded PVC or field coat with asphaltum before installation. After installation, completely coat damaged areas of coating.

### 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. Provide liquid-tight flexible metal conduit for installation in exterior locations, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray wash-down operations, inside (air stream) of HVAC units,

and locations subject to seepage or dripping of oil, grease or water. Provide a green ground wire with flexible metal conduit.

### 3.9 EXPANSION JOINTS

- A. Conduits 75 mm (3 inches) 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 inches) with junction boxes on both sides of the expansion joint. Connect conduits to junction boxes with sufficient slack of flexible conduit to produce 125 mm (5 inch) vertical drop midway between the ends. Flexible conduit shall have a copper green ground bonding jumper installed. In lieu of this flexible conduit, expansion and deflection couplings as specified above for 375 mm (15 inches) and larger conduits are acceptable.
- C. 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 green ground bonding jumper installed.

### 3.10 CONDUIT SUPPORTS, INSTALLATION

- A. Safe working load shall not exceed 1/4 of proof test load of fastening devices.
- B. Use pipe straps or individual conduit hangers for supporting individual conduits. Maximum distance between supports is 2.5 m (8 foot) on center.
- 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 90 kg (200 pounds). 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 (1/4 inch) bolt size and not less than 28 mm (1-1/8 inch) embedment.
    - b. Power set fasteners not less than 6 mm (1/4 inch) diameter with depth of penetration not less than 75 mm (3 inches).
    - c. Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.
- F. Hollow Masonry: Toggle bolts are permitted.

- 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.
- C. 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.
- D. Outlet boxes in the same wall mounted back-to-back are prohibited. A minimum 600 mm (24 inch), center-to-center lateral spacing shall be maintained between boxes.)
- E. Minimum size of outlet boxes for ground fault interrupter (GFI) receptacles is 100 mm (4 inches) square by 55 mm (2-1/8 inches) deep, with device covers for the wall material and thickness involved.
- F. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "SIG-FA JB No. 1".
- G. On all Branch Circuit junction box covers, identify the circuits with black marker.

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**SECTION 26 09 43**

**DIGITAL-NETWORK LIGHTING CONTROLS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

A. Section Includes:

1. Digital-Network Lighting Control System.

B. Related Sections and Systems:

1. Roller Window Shades.
2. Lighting Control Devices; Occupancy sensors.
3. Lighting panels (switching) controlled by Digital Network Lighting Control System.
4. Modular Dimming Controls.
5. Wiring Devices
6. Interior Lighting Fixtures, Lamps, and Ballasts. Fluorescent electronic dimming ballasts.
7. Integrated Automation (Building Management System)

**1.2 REFERENCES**

A. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE)

1. C62.41-1991 - Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.

B. ASTM International (ASTM).

1. D4674 -02a Standard Test Method for Accelerated Testing for Color Stability of Plastics Exposed to Indoor Fluorescent Lighting and Window-Filtered Daylight.

C. Canadian Standards Association (CSA).

1. CSA C22.2 # 14 Industrial Control Equipment
2. CSA C22.2 # 184 Solid-State Lighting Controls
3. CSA C22.2 # 156 Solid-State Speed Controls
4. CSA C22.2 # 42.1-00 Cover Plates for Flush Mounted Wiring Devices
5. CSA C22.2 # 42-99 General Use Receptacles

D. International Electrotechnical Commission.

1. (IEC) 801-2 Electrostatic Discharge Testing Standard.



2. IEC/EN 60669-2-1 Switches for household and similar fixed electrical installations - electronic switches.
- E. International Organization for Standardization (ISO).
1. 9001:2000 - Quality Management Systems.
- F. National Electrical Manufacturers Association (NEMA).
1. WD1 (R2005) - General Color Requirements for Wiring Devices.
  2. WD6 - Dimensional Specifications.
- G. Underwriters Laboratories, Inc. UL:
1. 94 - Flammability Rating
  2. 489 (2002) - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
  3. UL498 - Standard for Attachment Plugs and Receptacles.
  4. 508 (1999) - Standard for Industrial Control Equipment.
  5. UL514C - Standard for Non-metallic Outlet Boxes, Flush Device Boxes, and Covers.
  6. 916 - Energy Management Equipment.
  7. 924 (2003) - Emergency Lighting and Power Equipment
  8. 935 (2005) - Fluorescent Ballasts
  9. 1472 (1996) - Solid-State Dimming Controls.

### 1.3 SYSTEM DESCRIPTION

- A. System includes computer-based software that provides control, configuration, monitoring alerting and reports. System includes:
1. Lighting Management Panel
  2. System Manager - light management computer
  3. Light management computer software.
  4. Energy savings display software
  5. Factory assembled dimming and switching panels and power interfaces and power modules
  6. Low voltage wall stations and control interfaces and sensors.
  7. Solid-state high frequency fluorescent dimming ballasts.
  8. System components and ballast module interfaces (addressable fixture lighting control)
  9. Open Loop Solar Adaptive Shade Algorithm.
  10. Permanently installed occupancy/vacancy sensors and power packs.

### 1.4 SUBMITTALS

- A. Submit under provisions of Section 013300.

- B. Specification Conformance Document: Indicate whether the submitted equipment:
  - 1. Meets specification exactly as stated.
  - 2. Meets specification via an alternate means and indicate the specific methodology used.
- C. Shop Drawings; include:
  - 1. Schematic (one-line diagram) of system.
- D. Product Data: Catalog cut sheets with performance specifications demonstrating compliance with specified requirements.
- E. Sequence of Operation to describe how each area operates and how any building wide functionality is described.

#### **1.5 CLOSEOUT SUBMITTALS**

- A. Sustainable Design Closeout Documentation - Documentation (LSC-LEED-DOC)
  - 1. Lighting Control System Manufacturer to provide Enhanced Start-up documentation that details the start-up procedure being performed including a process to follow, details on tests performed and an area that documents any test results.

#### **1.6 QUALITY ASSURANCE**

- A. Manufacturer: Minimum 10 years experience in manufacture of lighting management systems.
- B. Manufacturer's Quality System: Registered to ISO 9001:2000 Quality Standard, including in-house engineering for product design activities.
- C. Lighting control system components:
  - 1. Listed by UL, CSA specifically for the required loads. Provide evidence of compliance upon request.

#### **1.7 PROJECT CONDITIONS**

- A. Do not install equipment until following conditions can be maintained in spaces to receive equipment:
  - 1. Ambient temperature: 0 degrees to 40 degrees C (32 degrees to 104 degrees F).
  - 2. Relative humidity: Maximum 90 percent, non-condensing.
  - 3. Lighting control system must be protected from dust during installation.
  - 4. Ambient temperature for system computer: 10 degrees to 35 degrees C (50 degrees to 90 degrees F)
  - 5. Relative humidity: Maximum 90 percent, non-condensing.
  - 6. Lighting control system must be protected from dust during installation.

## **1.8 WARRANTY**

- A. Provide manufacturer's 8 Year Limited Warranty and 2 Year Labor Coverage:
  - 1. 8-year limited parts warranty for the replacement of defective Lighting Components from the date of system startup completion, and
  - 2. 2-year 100 percent labor coverage from the date of the system startup completion.
- B. Provide Manufacturer's Support and Maintenance Plan for 8 years covering 100 percent parts and 100 percent labor and additional benefits as described below beginning 2 years after system startup completion.
  - 1. Support and Maintenance Plan, Includes:
    - a. 100 Percent Parts for Lighting System Components.
    - b. 100 Percent Labor Coverage for Troubleshooting and Diagnosis of Lighting Issues.
  - 2. 24 Hours Per Day, 7 Days Per Week Telephone Technical Support.
  - 3. 72-Hour On-Site Response Time.
  - 4. Remote Diagnostics for Applicable Systems.
  - 5. 4-Hours Remote Programming for Applicable Systems.
  - 6. Includes Service Coverage Upgrade of the Initial 2-year 100 Percent Labor Coverage.
- C. System Manager is covered by a 1-year parts and labor warranty.
- D. Provide manufacturer's warranty covering 5 years with startup on ballast modules from date of purchase.
- E. For ballasts, Fluorescent Electronic Dimming Ballasts.

## **1.9 MAINTENANCE MATERIAL SUBMITTALS**

- A. Make ordering of new equipment for expansions, replacements, and spare parts available to end-user.
- B. Make new replacement parts available for minimum of 10 years from date of manufacture.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. Lighting Controls: Ten-year operational life while operating continually at any temperature in an ambient temperature range of 0 degrees C (32 degrees F) to 40 degrees C (104 degrees F) and 90 percent non-condensing relative humidity.
- B. Designed and tested to withstand discharges without impairment of performance when subjected to discharges of 15,000 volts per IEC 801-2.

## 2.2 DIMMING / RELAY PERFORMANCE REQUIREMENTS

- A. Electrolytic capacitors to operate at least 20 degrees C below the component manufacturer's maximum temperature rating when device is under fully-loaded conditions in 40 degrees C (104 degrees F) ambient temperature.
- B. Load Handling Thyristors (SCRs and triacs), Field Effect Transistors (FETs), and Isolated Gate Bipolar Transistors (IGBTs): The component's maximum current rating to be at least two times the dimmer's/relay's rated operating current.
- C. Capable of withstanding repetitive inrush current of 50 times operating current without impacting lifetime of dimmer/relay.
- D. Design and test dimmers/relays to withstand line-side surges without impairment to performance.
  - 1. Panels: Withstand surges without impairment of performance when subjected to surges of 6,000 volts, 3,000 amps per ANSI/IEEE C62.41 and per IEC 61000-4-5 surge requirements.
  - 2. Other power handling devices: Withstand surges without impairment of performance when subjected to surges of 6,000 volts, 200 amps per ANSI/IEEE C62.41.
- E. Power failure memory and dimmer/relay recovery:
  - 1. When power is interrupted and subsequently returned, within 3 seconds lights will automatically return to same levels (dimmed setting, full on, or off) prior to power interruption.
- F. Dimmers:
  - 1. Provide real-time cycle-by-cycle compensation for incoming line voltage variations including changes in RMS voltage (plus or minus 2 percent change in RMS voltage/cycle), frequency shifts (plus or minus 2 Hz change in frequency/second), dynamic harmonics, and line noise.
  - 2. Systems not providing cycle-by-cycle compensation to include external power conditioning equipment as part of dimming system.
  - 3. Each dimmer to incorporate electronic "soft-start" default at initial turn-on that smoothly ramps lights up to the appropriate levels within 0.5 seconds.
  - 4. Utilize air gap off to disconnect the load from line supply.
  - 5. Control all light sources in smooth and continuous manor. Dimmers with visible steps are not acceptable.
  - 6. Each dimmer to be assigned a load type that will provide a proper dimming curve for the specific light source.
  - 7. Possess ability to have load types assigned per circuit, configured in field.
  - 8. Minimum and maximum light levels user adjustable on circuit-by-circuit basis.

9. Line Voltage Dimmers; Meet following load-specific requirements:
    - a. Magnetic Low Voltage (MLV) transformer:
      - 1) Contain circuitry designed to control and provide a symmetrical AC waveform to input of magnetic low voltage transformers per UL 1472, Section 5.11.
      - 2) Dimmers using unipolar load current devices (such as FETs or SCRs) to include DC current protection in the event of a single device failure.
    - b. Electronic Low Voltage (ELV) transformer:
      - 1) Dimmer to operate electronic low voltage transformers via reverse phase control. Alternately, forward phase control dimming may be used if dimming equipment manufacturer has recommended specific ELV transformers being provided.
    - c. Neon and cold cathode transformers:
      - 1) Magnetic transformers: UL listed for use with normal (low) power factor magnetic transformers. Electronic transformers: Must be supported by the ballast equipment manufacturer for control of specific ballasts being provided.
  10. Low Voltage Dimming Modules; Meet following requirements:
    - a. Coordination between low voltage dimming module and line voltage relay: Capable of being electronically linked to single zone.
    - b. Single low voltage dimming module; capable of controlling following light sources:
      - 1) 0-10V analog voltage signal.
        - a) Provide Class 2 isolated 0-10V output signal conforming to IEC 60929.
        - b) Sink current via IEC 60929.
        - c) Source current.
      - 2) 10-0V reverse analog voltage signal.
      - 3) DSI digital communication.
      - 4) DALI broadcast communication IEC 60929:
        - a) Logarithmic intensity values in compliance with IEC 60929.
        - b) Linear intensity values for use with LED color intensity control.
      - 5) PWM IEC 60929.
- G. Non-dim circuits to meet the following requirements:
1. Rated life of relay at full load: Minimum 1,000,000 cycles.
  2. Load switched in manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
  3. Fully rated output continuous duty for inductive, capacitive, and resistive loads.

## 2.3 POWER PANELS

### A. Mechanical:

1. Listed to UL 508 as industrial control equipment. CSA certified, or NOM approved as applicable.
2. Delivered and installed as a UL [CSA] listed factory assembled panel.
3. Field wiring accessible from front of panel without need to remove dimmer assemblies or other components.
4. Panels passively cooled via free-convection, unaided by fans or other means.
5. Ship panels with each dimmer in mechanical bypass position by means of jumper bar inserted between input and load terminals. Jumpers to carry full rated load current and be reusable at any time. Mechanical bypass device to allow for switching operation of connected load with dimmer removed by means of circuit breaker.

B. Electrical:

1. Panels contain branch circuit protection for each input circuit unless the panel is a dedicated feed-through type panel or otherwise indicated on the drawings.
2. Branch circuit breakers; meet following performance requirements:
  - a. Listed to UL 489 as molded case circuit breaker for use on lighting circuits.
  - b. Contain visual trip indicator; rated at, 14,000 AIC, 277 V Dimming, 18,000 AIC, 277 V Switching.
  - c. Thermal-magnetic construction for overload, short-circuit, and over-temperature protection. Use of breakers without thermal protection requires dimmers/relays to have integral thermal protection to prevent failures when overloaded or ambient temperature is above rating of pane.
  - d. Accept tag-out/lock-out devices to secure circuit breakers in off position when servicing loads.
  - e. Replaceable without moving or replacing dimmer/relay assemblies or other components in panel. UL listed as switch duty (SWD) so that loads can be switched on and off by breakers.
3. Minimum UL listed Short Circuit Current Rating (SCCR) of 65,000A.
4. Utilize air gap off to disconnect the load from line supply.

C. Architectural Lighting Control Panel

1. Dimmers designed and tested to specifically control incandescent/tungsten, magnetic low voltage, electronic low voltage, neon/cold cathode, fluorescent dimming ballasts, and non-dim loads.
2. Utilize multiple load type low voltage dimming module.
3. Limit current rise time to minimum 350  $\mu$ sec as measured from 10-90 percent of load current waveform and minimum 525  $\mu$ sec as measured from 0-100 percent of load current waveform at 50 percent rated dimmer capacity at a 90 degree conduction angle. Current rise to be minimum 400  $\mu$ sec as measured from 10-90 percent of load current waveform and minimum 600  $\mu$ sec as measured from 0-100 percent of load current waveform at 100 percent rated dimmer capacity at a 90 degree conduction angle.

4. Load faults only affect the given circuit.
- D. Light Duty Commercial Lighting Control Panel:
1. Flush into wall
  2. Utilize multiple load type 16A feed continuous-use UL listed dimming/switching modules.
  3. For switching only circuits, utilize 1,000,000 cycle relay.
  4. Utilize multiple load type low voltage dimming module.
- E. Switching Panels:
1. Flush into wall.
  2. Rated life of relay: Minimum 1,000,000 cycles.
  3. Load switched in manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
  4. Fully rated output continuous duty for inductive, capacitive, and resistive loads.
- F. DC Dimming Panels:
1. Meet recommended electrical noise levels of MRI system manufacturers.
  2. Lamps: Free from audible noise and flicker throughout entire dimming range.
  3. In case of control system failure, supervisory circuit shall shut down power to load.
  4. Automatically detect and compensate for lamp failures to maintain consistent DC voltage level
- G. Panel Processor:
1. Provide following capabilities:
    - a. Operate circuits directly from panel processor for system diagnostics and provide feedback of system operation.
    - b. Electronically assign each circuit to any zone in lighting control system.
    - c. Determine normal/emergency function of panel and set emergency lighting levels.
  2. Where indicated on Drawings, panels to provide two control links. Each circuit to be capable of transferring control based on independent programming between architectural control system and theatrical controls utilizing the USITT DMX-512 1990 or ESTA DMX-512A protocol.
  3. React to changes from control within 20 milliseconds.
- H. Diagnostics and Service:
1. Replacing dimmer/relay does not require re-programming of system or processor.
  2. Dimmers/relays: Include diagnostic LEDs to verify proper operation and assist in system troubleshooting.

3. Dimming/relay panels: Include tiered control scheme for dealing with component failure that minimizes loss of control for occupant.
  - a. If lighting control system fails, lights to remain at current level. Panel processor provides local control of lights until system is repaired.
  - b. If panel processor fails, lights to remain at current level. Circuit breakers can be used to turn lights off or to full light output, allowing non-dim control of lights until panel processor is repaired.
  - c. If dimmer fails, factory-installed mechanical bypass jumpers to allow each dimmer to be mechanically bypassed. Mechanical bypass device to allow for switching operation of connected load with dimmer removed by means of circuit breaker.

#### 2.4 POWER INTERFACES

- A. Electrical:
  1. Phase independent of control input.
  2. Dimmer to meet limited short circuit test as defined in UL 508.
  3. Utilize air gap off to disconnect the load from line supply
- B. Diagnostics and Service: Replacing power interface does not require re-programming of system or processor.

#### 2.5 POWER MODULES

- A. Preset lighting control with zone override:
  1. Intensity for each zone indicated by means of one illuminated bar graph per zone.
  2. User-programmable zone and scene names.
  3. Utilize air gap off to disconnect the load from line supply
  4. Astronomical time clock and programmer interface
    - a. Provide access to:
      - 1) Scene selections.
      - 2) Fade zone to a level.
      - 3) Fine-tuning of preset levels with scene raise/lower.
      - 4) Lock out scenes and zones.
      - 5) Fine-tuning of light levels with individual zone raise/lower.
      - 6) Terminal block for wired infrared signal input.
      - 7) Enable/disable wall station.
  5. Light intensity with real time energy savings by digital display.
  6. Fade time indicated by digital display for current scene while fading.
  7. Integral wide angle infrared receiver.



8. For temporary local overrides, individual raise/lower buttons to allow zones to be adjusted without altering scene values stored in memory.
9. Direct low-voltage control of digital ballasts (120V, and 277V lighting):
  - a. Electronically link a digital fluorescent lighting ballast to a zone for both dimming and turn on/off
  - b. Electronically assign daylight sensors to digital ballasts and line voltage dimmers for proportional daylight harvesting
  - c. Single integral controller with Class 1 or Class 2 isolated digital output signal conforming to IEC 60929; capable of direct (no-interface) control.

**B. Preset shade control with zone override:**

1. Preset expandable shade control: Provide up to 3 columns of shade control.
2. For temporary local overrides, individual raise/lower buttons to allow zones to be adjusted without altering scene values stored in memory.

**2.6 LIGHTING CONTROL MODULE**

**A. Switching Lighting Control Module:**

1. Mechanical:
  - a. Listed to UL 508 (United States) as industrial control equipment.
  - b. Delivered and installed as a UL listed factory assembled panel.
  - c. Panels passively cooled via free-convection, unaided by fans or other means.
2. Surface mounted
3. Switching:
  - a. Rated life of relay: Minimum 1,000,000 cycles.
  - b. Load switched in manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
  - c. Fully rated output continuous duty for inductive, capacitive, and resistive loads.
  - d. Module to integrate up to 4 individually controlled zones, each with a capacity of up to 16 amps, of high in-rush lighting load (magnetic fluorescent ballast, electronic fluorescent ballast, incandescent, magnetic low-voltage, electronic low-voltage, neon/cold cathode and motor loads).
  - e. Utilize air gap off - activated when user selects "off" at any control to disconnect the load from line supply.
4. Connection without interface to wired:
  - a. Occupancy sensors
  - b. Daylight sensors
  - c. IR receivers for personal control
5. Capable of being controlled via wireless sensors and controls

6. Connects to Lighting Management Panel via RS485.
  7. LED status indicators confirm communication with occupancy sensors, daylight sensors, and IR receivers.
  8. Contact Closure Input
    - a. Directly accept contact closure input from a dry contact closure or solid-state output without interface to:
      - 1) Activate scenes.
        - a) Scene activation from momentary or maintained closure.
      - 2) Enable or disable afterhours.
        - a) Automatic sweep to user-specified level after user-specified time has elapsed
        - b) System will provide occupants a visual warning prior to sweeping lights to user-specified level
        - c) Occupant can reset timeout by pressing a button on a control station
      - 3) Activate or deactivate demand response (load shed).
        - a) Load shed event will reduce lighting load by user-specified amount.
  9. Emergency Contact Closure Input.
    - a. Turn all zones to full output during emergency state via direct contact closure input from UL 924 Listed Emergency Lighting Interface, security system or fire alarm system
    - b. Allow configurable zone response during emergency state.
    - c. Disable control operation until emergency signal is cleared.
  10. System Programming:
    - a. Supports system programming via built-in user interface requiring no external programming devices
    - b. Provide ability for programming from a wireless router.
- B. 0-10V Lighting Control Module:
1. Meet the following requirements:
    - a. Coordination between low voltage dimming module and line voltage relay: Capable of being electronically linked to single zone.
    - b. Single low voltage dimming module; capable of controlling following light sources:
      - 1) 0-10V analog voltage signal.
        - a) Provide Class 2 isolated 0-10V output signal conforming to IEC 60929.
        - b) Sink current per IEC 60929.
      - 2) 10V - 0V analog voltage signal.
        - a) Provide Class 2 isolated 0-10V output signal conforming to IEC 60929.
        - b) Sink current per IEC 60929.
  2. Mechanical:
    - a. Listed to UL 508 (United States) as industrial control equipment.

- b. Delivered and installed as a UL listed factory assembled panel.
  - c. Panels passively cooled via free-convection, unaided by fans or other means.
3. Surface mounted
4. Switching:
- a. Rated life of relay: Minimum 1,000,000 cycles.
  - b. Load switched in manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
  - c. Fully rated output continuous duty for inductive, capacitive, and resistive loads.
  - d. Module to integrate up to 4 individually controlled zones, each with a capacity of up to 16 amps, of high in-rush lighting load (magnetic fluorescent ballast, electronic fluorescent ballast, HID, incandescent, magnetic low-voltage, electronic low-voltage, neon/cold cathode and motor loads).
  - e. Utilize air gap off - activated when user selects "off" at any control to disconnect the load from line supply.
5. Connection without interface to wired:
- a. Occupancy sensors
  - b. Daylight sensors
  - c. IR receivers for personal control
6. Capable of being controlled via wireless sensors and controls
7. Connects to Lighting Management Panel via RS485.
8. LED status indicators confirm communication with occupancy sensors, daylight sensors, and IR receivers.
9. Contact Closure Input
- a. Directly accept contact closure input from a dry contact closure or solid-state output without interface to:
    - 1) Activate scenes
      - a) Scene activation from momentary or maintained closure
    - 2) Enable or disable afterhours
      - a) Automatic sweep to user-specified level after user-specified time has elapsed
      - b) System will provide occupants a visual warning prior to sweeping lights to user-specified level
      - c) Occupant can reset timeout by interacting with the lighting system
    - 3) Activate or deactivate demand response (load shed)
      - a) Load shed event will reduce lighting load by user-specified amount
10. Emergency Contact Closure Input
- a. Turn all zones to full output during emergency state via direct contact closure input from UL 924 Listed Emergency Lighting Interface, security system or fire alarm system
  - b. Allow configurable zone response during emergency state.

- c. Disable control operation until emergency signal is cleared.
- 11. System Programming
  - a. Supports system programming via built-in user interface requiring no external programming devices.
  - b. Provide ability for programming from an Apple iPod touch, iPhone, or iPad via wireless router.
- C. Digital Fixture Lighting Control Module
  - 1. Mechanical:
    - a. Listed to UL 508 (United States) as industrial control equipment.
    - b. Delivered and installed as a UL listed factory assembled panel.
    - c. Panels passively cooled via free-convection, unaided by fans or other means.
  - 2. Provide smart diagnostics for system verification.
  - 3. Provide testing capability using manual override buttons.
  - 4. Support two low-voltage digital communication links of up to 64 ballasts per link capable of NEC Class 1 or Class 2 installation
  - 5. Connect without interface to wired.
    - a. Occupancy sensors
    - b. Daylight sensors
    - c. IR receivers for personal control
  - 6. Capable of being controlled via wireless sensors and controls
  - 7. Connects to Lighting Management Panel via RS485.
  - 8. LED status indicators confirm communication with occupancy sensors, daylight sensors, and IR receivers.
  - 9. Contact Closure Input
    - a. Directly accept contact closure input from a dry contact closure or solid-state output without interface to:
      - 1) Activate scenes
        - a) Scene activation from momentary or maintained closure
      - 2) Enable or disable afterhours
        - a) Automatic sweep to user-specified level after user-specified time has elapsed
        - b) System will provide occupants a visual warning prior to sweeping lights to user-specified level
        - c) Occupant can reset timeout by interacting with the lighting system
      - 3) Activate or deactivate demand response (load shed)
        - a) Load shed event will reduce lighting load by user-specified amount
  - 10. Emergency Contact Closure Input
    - a. Turn all zones to full output during emergency state via direct contact closure input from UL 924 Listed Emergency Lighting Interface, security system or fire alarm system

- b. Disable control operation until emergency signal is cleared.
- 11. Programming Connection:
  - a. Provide Ethernet input for wired connection to wireless router.
  - b. Provide ability for programming from a wireless router.
- D. Total Light Management Control Module
  - 1. Mechanical:
    - a. Listed to UL 508 (United States) as industrial control equipment.
    - b. Delivered and installed as a ULlisted factory assembled panel.
    - c. Panels passively cooled via free-convection, unaided by fans or other means.
  - 2. Ten fused 30W (60W peak) 24VDC outputs provide power shades, drapery drive units, keypads, and accessories.
  - 3. Provide power for 10 to 30 shades dependent on shade dimensions.
  - 4. Provide smart diagnostics for system verification.
  - 5. Provide testing capability using manual override buttons
  - 6. Support two low-voltage digital communication links of up to 64 ballasts per link capable of NEC Class 1 or Class 2 installation
  - 7. Connect without interface to wired.
    - a. Occupancy sensors
    - b. Daylight sensors
    - c. IR receivers for personal control
  - 8. Connects to Lighting Management Panel via RS485.
  - 9. LED status indicators confirm communication with occupancy sensors, daylight sensors, and IR receivers.
  - 10. Contact Closure Input.
    - a. Directly accept contact closure input from a dry contact closure or solid-state output without interface to:
      - 1) Activate scenes
        - a) Scene activation from momentary or maintained closure
      - 2) Enable or disable afterhours
        - a) Automatic sweep to user-specified level after user-specified time has elapsed
        - b) System will provide occupants a visual warning prior to sweeping lights to user-specified level
        - c) Occupant can reset timeout by interacting with the lighting system.
      - 3) Activate or deactivate demand response (load shed)
        - a) Load shed event will reduce lighting load by user-specified amount
  - 11. Emergency Contact Closure Input
    - a. Turn all zones to full output during emergency state via direct contact closure input from UL 924 Listed Emergency Lighting Interface, security system or fire alarm system

- b. Disable control operation until emergency signal is cleared.
- 12. Programming Connection:
  - a. Provide Ethernet input for wired connection to wireless router.
  - b. Provide ability for programming from a wireless router.

## 2.7 DIMMING BALLAST AND SWITCHING MODULES

### A. General

- 1. Continuous 3-Wire signal dimming to 3-Wire electronic dimming ballast.
- 2. Connect without interface to:
  - a. Occupant sensor (motion detector).
  - b. Daylight sensor.
  - c. Personal control input (wall station or infrared receiver).
- 3. Generate digital communication commands to distribute ballast and sensor data on the digital bus.
- 4. Utilize air gap off to disconnect the load from line supply.
- 5. If power is interrupted and subsequently returned, lights automatically return to the setting prior to power interruption.
- 6. Each ballast responds independently to:
  - a. Up to 32 occupant sensors.
  - b. Up to 64 personal control inputs.
  - c. 2 daylight sensors.
- 7. Unique internal reference number visibly displayed on module cover.
- 8. Averages 2 independent daylight harvesting inputs internally.
- 9. Responds to digital load shed command
  - a. Sets high end trim.
  - b. Automatically scales light output proportional to load shed command.
    - 1) Example: If light output is at 30 percent and a load shed command of 10 percent is received, the ballast automatically sets the maximum light output at 90 percent and lowers current light output by 3 percent to 27 percent.
- 10. Electrical: Dimmer to meet limited short circuit test as defined in UL 20.
- 11. Provide integral fault protection to prevent ballast module failure in the event of a mis-wire.

### B. 16 Amp (BMJ) 3-Wire Ballast Module

- 1. Ballast module to integrate up to 16 amps of 3-wire electronic dimming ballast into a control system as a single zone.
- 2. Module to integrate up to 16 amps of switched high intensity discharge lighting load (HID) into a control system as a single zone.

- C. 16 Amp (XPJ) Switching Ballast Module
  - 1. Module to integrate up to 16 amps of high in-rush lighting load (magnetic fluorescent ballast, electronic fluorescent ballast, HID, incandescent, magnetic low-voltage, electronic low-voltage, neon/cold cathode and motor loads) into a control system as a single zone.

## 2.8 LIGHTING MANAGEMENT PANEL

- A. Provide Lighting Management Panel in a pre-assembled NEMA listed enclosure with terminal blocks listed for field wiring.
- B. Enables Light Management software to control and monitor dimming ballasts, System modules, Power Panels, wall stations, and window treatments.
  - 1. Lighting Management Panel utilizes Ethernet connectivity to System Manager.
    - a. Dedicated Network Environment is used to connect System Manager with Lighting Management Panels.
- C. Integrate control station devices, power panels, shades, preset lighting controls, and external inputs into single customizable, multiple failsafe lighting control system, operable manually, automatically or through computer control.
- D. Astronomical time clock.
- E. Solar clock to track the position of the sun to control the shades to limit penetration of direct sunlight.
- F. Maintains a backup of the programming in a non-volatile memory capable of lasting more than ten years without power.
- G. BACnet Integration License for Lights
  - 1. Provide ability to communicate by means of BACnet IP communication to Control system from a user-supplied 10BASE-T or 100BASE-T Ethernet network.
  - 2. Each Lighting Management Panel processor requires license for BACnet integration.
  - 3. Basic BACnet integration license for lights
    - a. The BACnet integrator can command:
      - 1) Area light output
      - 2) Area enable or disable afterhours mode
      - 3) Area load shed level
      - 4) Area load shed enable/disable
    - b. The BACnet integrator can monitor:
      - 1) Area on/off status
      - 2) Area occupancy status
      - 3) Area fault
      - 4) Area load shed status

5) Area instantaneous energy usage

H. BACnet Integration License for Shades

1. Provide ability to communicate by means of BACnet IP communication to Control system from a user-supplied 10BASE-T or 100BASE-T Ethernet network.
2. Each Lighting Management Panel processor requires license for BACnet integration.
3. Basic BACnet integration license for shades
  - a. The BACnet integrator can activate area shade group presets.
  - b. The BACnet integrator can monitor area shade group presets.
4. Shade assignment and grouping will be self discoverable with 3<sup>rd</sup> party building management software.

**2.9 LIGHT MANAGEMENT SYSTEM COMPUTER**

A. PC/Laptop

1. Used for occasional programming, monitoring, and control of digital network lighting controls.
2. Computer to be provided by the lighting control system manufacturer.
3. Computer software preinstalled and tested prior to shipping.

B. Server

1. Used for 24 hour per day, 7 day per week programming, monitoring, control, graphics, and data logging of digital network lighting controls.
2. Used to handle client machine request in multi-computer systems.
3. Computer to be provided by the lighting control system manufacturer.
4. Computer software preinstalled and tested prior to shipping.

**2.10 LIGHTING MANAGEMENT SYSTEM SOFTWARE**

A. Provide system software license and hardware that is designed, tested, manufactured, and warranted by a single manufacturer.

B. Configuration Setup

1. Used to make system programming and configuration changes
2. Windows based, capable of running on either central server or a remote client over TCP/IP connection
3. Allow user to:
  - a. Capture system design.
    - 1) Geographical Layout
    - 2) Load Schedule Zoning
    - 3) Shade Grouping
    - 4) Equipment Schedule



- 5) Equipment assignment to lighting management panels
  - 6) Daylighting design
  - b. Define the configuration for the following in each area:
    - 1) Lighting Scenes
    - 2) Shade Group Presets
    - 3) Control Station Devices
    - 4) Interface and Integration Equipment
    - 5) Occupancy/After Hours
    - 6) Partitioning
    - 7) Daylighting
    - 8) Emergency Lighting
    - 9) Nitelights
  - c. Start-up
    - 1) Addressing
    - 2) Daylighting
- C. Control and Monitor
- 1. Basic System View
    - a. Control system navigation and status reporting is performed using a tree view of the building.
  - 2. Graphical Floorplan View
    - a. The Control system navigation and status reporting is performed using customized CAD based drawings of the building. Pan and Zoom feature allows for easy navigation. Basic system view is always available.
  - 3. Control of Lights & Shades
    - a. Area lights can be monitored for on/off status.
    - b. All lights in an area can be turned on/off or sent to a specific level.
    - c. For areas that have been zoned, these areas may be sent to a predefined lighting scene, and individual zones may be controlled.
    - d. Area lighting scenes can be modified in real-time, changing the levels zones go to when a scene is activated.
    - e. Area shades can be monitored for current preset or position.
    - f. Area shades can be opened/closed, sent to a preset, or sent to a specific position.
  - 4. Occupancy
    - a. Area occupancy can be monitored.
    - b. Area occupancy can be disabled to override occupancy control or in case of occupancy sensor problems.
    - c. Area occupancy settings including level lights turn on to when area is occupied, and level lights turn off to when area is unoccupied can be changed in real-time.
  - 5. Daylighting

- a. Daylighting can be enabled/disabled. This can be used to override the control currently taking place in the space.
- b. Daylight target levels can be changed for each daylit area. This is particularly useful when new departments move into a space.
6. Load Shedding
  - a. Load shedding allows the building manager to monitor whole building lighting power usage and apply a load shed reduction to selected areas, thereby reducing a building's power usage.
7. Scheduling
  - a. Schedule time of day and astronomic timeclock events to automate functions for lights and shades.
8. Reporting allows the building manager to gather real-time and historical information about the system as follows:
  - a. Energy Reports - Show a comparison of cumulative energy used over a period of time for one or more areas.
  - b. Power Reports - Show power usage trend over a period of time for one or more areas.
  - c. Activity Report - Shows what activity has taken place over a period of time for one or more areas. Activity includes occupant activities (i.e. areas going occupied/unoccupied, wall controls being pressed), building manager operation (controlling/changing areas using the control & monitor tool), and device failures (keypads, ballasts, etc. not responding).
  - d. Lamp Failure Report - Shows which areas are currently reporting lamp failures.
9. Diagnostics
  - a. Diagnostics allows the building manager to check on the status of all equipment in the lighting control system. Devices will be listed with a reporting status of OK, missing, or unknown.
10. Administration
  - a. Users - Allows new user accounts to be created and existing user accounts to be edited.
  - b. Publish Graphical Floorplan - Allows admin user to publish new graphical floorplan files, allowing users to monitor the status of lights, occupancy of areas, and daylighting status.
  - c. Back-up Project Database - Allows admin user to backup the project database. The project database holds all the configuration information for the system, including keypad programming, area scenes, daylighting, occupancy programming, emergency levels, night lights, and timeclock. The Control and Monitor tool can be used to adjust some of these settings, and thus it is important to back-up the project database prior to changing settings in the Design and Setup tool.
11. Publish Project Database - Allows the admin user to send a new project database to the server and download the new configuration to the system. The project database holds all the configuration information for the system, including keypad programming, area scenes, daylighting, occupancy programming, emergency levels, night lights, and timeclock.

D. Energy Savings display software

1. Provide software from a single manufacturer that can collect and display energy savings from all of the lighting components in the lighting control system.

E. Open Loop Solar Adaptive Algorithm

1. Primary Goals of the shade control system are:
  - a. Optimize daylight.
  - b. Provide manual override capability for occupants via wall mounted keypad or simple remote control.
  - c. Maximize occupants connectivity with outdoors by optimizing view.
  - d. Provide diffuse daylight and minimize direct sunlight in the space to reduce solar heat gain and maximize occupants' comfort in the space.
  - e. Reduce glare.
  - f. Shades along same façade will, start, stop and track in unison to maintain a consistent exterior aesthetic.
2. Hardware
  - a. Independent operation of solar tracking program through non-windows based operating system provided in one or more lighting management panels.
3. Control Software
  - a. Control software shall incorporate a solar tracking software that:
    - 1) Calculates the sun's position in the sky relative to the building and then calculates when shade movement is necessary by façade.
    - 2) Calculates the position of the shade to limit direct sunlight penetration to a predetermined limit
  - b. Control software shall be controlled using the following inputs for start up:
    - 1) Building location
    - 2) Façade orientation
    - 3) Window Dimensions
    - 4) Solar depth of penetration
    - 5) Number of shade movements per day
  - c. Control software shall require minimal long term maintenance and service. System will not require user to make daily changes to programming or overall system functionality, unless desired by the owner.
4. User Interface
  - a. PC Graphic User Interface
    - 1) User Interface will provide access to all adjustable parameters of solar depth of penetration and number of shade movements per day
  - b. Manual Override

- 1) Temporary override of the control program shall be capable through optional manual keypads.
- 2) Keypads shall be capable of providing manual control of shades in a particular area.

## 2.11 LOW-VOLTAGE WALL STATIONS

### A. System Wall Stations

1. Allows controls of any devices part of the Control System.
2. Product: Preset Lighting Controls with Zone Override
3. Electronics:
  - a. Use RS485 wiring for low voltage communication.
4. Functionality:
  - a. Upon button press, LEDs to immediately illuminate.
  - b. LEDs to reflect the true system status. LEDs to remain illuminated if the button press was properly processed or the LEDs turn off if the button press was not processed.
  - c. Allow for easy reprogramming without replacing unit.
  - d. Replacement of units does not require reprogramming.
5. Color:
  - a. Match NEMA WD1, Section 2.
  - b. Color variation in same product family: Maximum  $\Delta E=1$ , CIE  $L^*a^*b$  color units.
  - c. Visible parts: Exhibit ultraviolet color stability when tested with multiple actinic light sources as defined in ASTM D4674. Provide proof of testing upon request.
6. Provide faceplates with concealed mounting hardware.
7. Engrave wall stations in English with appropriate button, zone, and scene engraving descriptions.
8. Silk-screened borders, logos, and graduations to use graphic process that chemically bonds graphics to faceplate, resistant to removal by scratching and cleaning.
9. Software Configuration:
  - a. Customizable control station device button functionality:
    - 1) Buttons can be programmed to perform single defined action.
    - 2) Buttons can be programmed to perform defined action on press and defined action on release.
10. Control station device LEDs to support logic that defines when it is illuminated:
  - a. Scene logic (logic is true when all zones are at defined levels).
  - b. Room logic (logic is true when at least one zone is on).
  - c. Pathway (logic is true when at least one zone is on).
  - d. Last scene (logic is true when spaces are in defined scenes).

### B. Digital Ballast Wall Stations

1. General:
  - a. Class 2 (low voltage).
  - b. Integral IR receiver for personal control.
  - c. Immediate local LED response upon button activation to indicate that a system command has been requested.
  - d. Wall stations can be replaced without reprogramming.
2. Color:
  - a. Match NEMA WD1, Section 2 White.
  - b. Color variation in same product family: Maximum  $\Delta E=1$ , CIE  $L^*a^*b$  color units.
  - c. Visible parts: Exhibit ultraviolet color stability when tested with multiple actinic light sources as defined in ASTM D4674. Provide proof of testing upon request.
3. One Button Control
  - a. Toggle on/off and master raise/lower control for group of fixtures.
4. Four Button Control
  - a. Recall 4 Scenes plus all on or all off for one group of fixtures.
  - b. Master raise/lower control entire group of fixtures.

#### 2.12 LOW VOLTAGE CONTROL INTERFACES

- A. Contact Closure Interface;
  1. The contact closure input device will accept both momentary and maintained contact closures.
  2. The contact closure output device can be configured for maintained or pulsed outputs.
- B. Contact Closure Input Interface;
  1. The contact closure input device will accept both momentary and maintained contact closures.
- C. RS232 and Ethernet Interface;
  1. Provide ability to communicate via ethernet or RS232 to audiovisual equipment, touchscreens, etc.
  2. Provide control of:
    - a. Lights scene selections.
    - b. Shade Group Presets.
    - c. Fine-tuning of shade preset or light scenes levels with raise/lower.
    - d. Simulate system wall station button presses and releases.
  3. Provide status monitoring of:
    - a. Light scene-status.
    - b. Shade Group status.
    - c. Wall station button presses and releases.

D. DMX Interface

1. Product: QSE-CI-DMX
2. Provide ability to:
  - a. Map a single zone intensity from a GRAFIK Eye QS control unit to a single DMX512 channel
  - b. Map a single zone intensity from a GRAFIK Eye QS control unit to 3 DMX512 channels for RGB/CMY color-control.

E. Wired and Wireless Sensor Module

1. Provide wired inputs for:
  - a. Occupancy sensors
  - b. Daylight sensors
  - c. IR receivers for personal control
  - d. Digital Ballast Wall Stations
2. Wireless Integration
  - a. Provide wireless communication inputs for:
    - 1) Occupancy sensors
    - 2) Daylight sensors
    - 3) Wireless Controller
  - b. Provide RF range of 18 meters (60 feet) line of sight or 9 meters (30 feet) through typical construction materials.
  - c. RF frequency of 434 MHz
3. Communicate sensor information to wired QS link for use by compatible devices.

F. Wired Sensor Module

1. Provide wired inputs for:
  - a. Occupancy sensors
  - b. Daylight sensors
  - c. IR receivers for personal control
  - d. Digital Ballast Wall Stations
2. Communicate sensor information to wired QS link for use by compatible devices.

G. Wireless Sensor Module

1. Wireless Integration
  - a. Provide wireless communication inputs for
    - 1) Occupancy sensors
    - 2) Daylight sensors
    - 3) Wireless Controller
  - b. Provide RF range of 18 meters (60 feet) line of sight or 9 meters (30 feet) through typical construction materials
  - c. RF frequency of 434 MHz.

2. Communicate sensor information to wired QS link for use by compatible devices.

### 2.13 SENSORS

#### A. Ceiling and Wall Mount Occupancy/Vacancy Sensors

1. Sensing mechanism:
  - a. Infrared: Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
  - b. Ultrasonic: Utilize an operating frequency of 32kHz or 40kHz that shall be crystal controlled to operate within plus or minus 0.005 percent tolerance.
  - c. Dual technology:
    - 1) Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
    - 2) Utilize an operating frequency of 32kHz or 40kHz that shall be crystal controlled to operate within plus or minus 0.005 percent tolerance.
2. Connect directly to System ballast and modules without the need of a power pack or other interface
3. Sensors shall turn off or reduce lighting automatically after reasonable time delay when a room or area is vacated by the last person to occupy the space
4. Sensor shall accommodate all conditions of space utilization and all irregular work hours and habits.
5. Sensors shall be UL, listed (as appropriate)
6. Sensors shall be fully adaptive and adjust their sensitivity and timing to ensure optimal lighting control for any use of the space
7. Sensors shall have field adjustable controls for time delay and sensitivity to override any adaptive features.
8. Power failure memory:
  - a. Controls incorporate non-volatile memory. Should power be interrupted and subsequently restored, settings and learned parameters saved in protected memory shall not be lost.
9. Provide all necessary mounting hardware and instructions.
10. Sensors shall be Class 2 devices.
11. Indicate viewing directions on mounting bracket for all Ceiling mount sensors.
12. Provide customizable mask to block off unwanted viewing areas for all ceiling mounted sensors using infrared technology.
13. Provide swivel mount base for all wall mount sensors.
14. Provide an internal additional isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC control, Data Logging and other control options.

#### B. Sensor Power Packs

1. For ease of mounting, installation and future service, power pack(s) shall be able to mount through a 1/2" knock-out in a standard electrical enclosure and be an integrated, self-contained unit consisting internally of an isolated load switching control relay and a transformer to provide low-voltage power. Transformer shall provide power to a minimum of three (3) sensors.
2. Power pack shall be plenum rated
3. Control wiring between sensors and control units shall be Class 2, 18-24 AWG, stranded U.L. Classified, PVC insulated or TEFLON jacketed cable suitable for use in plenums, where applicable.

C. Infrared Receivers

1. Use Class 2 wiring for low voltage communication
2. Can be replaced without reprogramming
3. 360 degree reception of wireless infrared remote controls
4. Immediate local LED response upon reception of hand held transmitter communication
5. Constructed with plastic meeting UL94 HB
6. Mountable on lighting fixtures or recessed acoustical ceiling tiles
7. Constructed via sonic welding
8. Color:
  - a. Match NEMA WD1, Section 2 White
  - b. Color variation in same product family: Maximum  $\Delta E=1$ , CIE L\*a\*b color units
  - c. Visible parts: Exhibit ultraviolet color stability when tested with multiple actinic light sources as defined in ASTM D4674. Provide proof of testing upon request.

D. Interior Daylight Sensors

1. Use Class 2 wiring for low voltage communication
2. Can be replaced without reprogramming
3. Open-loop basis for daylight sensor control scheme
4. Stable output over temperature from 0° to 40° C
5. Partially shielded for accurate detection of available daylight to prevent fixture lighting and horizontal light component from skewing sensor detection
6. Provide linear response from 0 to 500 foot-candles
7. Integral IR receiver for personal control
8. Constructed with plastic meeting UL94 HB
9. Mountable on lighting fixtures or recessed acoustical ceiling tiles
10. Constructed via sonic welding
11. Color:
  - a. Match NEMA WD1, Section 2 White



- b. Color variation in same product family: Maximum  $\Delta E=1$ , CIE L\*a\*b color units
- c. Visible parts: Exhibit ultraviolet color stability when tested with multiple actinic light sources as defined in ASTM D4674. Provide proof of testing upon request.

E. Exterior Daylight Sensors

- 1. Calibrated with independent turn-on and turn-off thresholds; minimum 2 foot-candles difference between the turn-on and turn-off thresholds.
- 2. Enclosed in weatherproof housing with shading and lens protection visor.

F. Infrared Partition Sensor

- 1. Provide contact closure based on status of the partition wall (open/close).

**2.14 ACCESSORIES**

A. Emergency Lighting Interface;

- 1. Provides total system listing to UL924 when used with the Control system.
- 2. Senses all three phases of building power.
- 3. Provides an output to power panels or Digital Ballast Interfaces if power on any phase fails and sends all lights controlled by these devices to an emergency light level setting of 100 percent intensity. Lights to return to their previous intensities when normal power is restored.
- 4. Include a contact closure input from the fire alarm control panel.

B. Infrared Transmitters:

- 1. Provide wireless remote control.
- 2. Designed for use in conjunction with compatible infrared receiver and lighting control; compatibility dependent on that receiver, not transmitter.
- 3. Operate up to 15 meters (50 feet) within line-of-sight to that receiver.
- 4. "Learnable" by other variable frequency remote controls.

**2.15 WIRING DEVICE ACCESSORIES**

A. General

- 1. Provide receptacle, telephone jack, and cable TV jack, and wall plate kits that are designed, tested, manufactured, warranted, and provided by a single manufacturer unless otherwise noted.
- 2. Provide seamless faceplates with no visible means of attachment.
- 3. Color

- a. Match NEMA WD1, Section 2.
- b. Color variation in same product family: Maximum  $\Delta E=1$ , CIE L\*a\*b color units.
- c. Visible parts: Exhibit ultraviolet color stability when tested with multiple actinic light sources as defined in ASTM D4674. Provide proof of testing upon request.

B. Receptacle Components

1. Receptacles listed to UL 498, CSA C22.2 #42-99, NOM-003-SCFI
2. Receptacles NEMA configuration type 20 Amp.
3. Isolated ground NEMA configuration type receptacles 20 Amp.
4. Dimmable receptacles NEMA configuration type full duplex dimmable 15 Amp.
5. Ground-fault interrupter NEMA WD-6 design configuration type receptacles 20 Amp.

C. Telephone Jack and Cable TV Components

1. Comply with NEC Articles 800-3 and 820-13 by providing an appropriate barrier (partition) to isolate jack from high-voltage wiring when ganged with a dimmer, fan-speed control, switch, or receptacle.
2. Telephone jacks meet FCC Part 68, paragraph F standards to ensure compatibility with U.S. telephone systems
3. Telephone jacks: designed to mate with standard 4- or 6-conductor modular jacks, and be compatible with 2, 4, or 6 conductor lines.
4. Cable TV jacks: coaxial type, designed for use with standard 75-Ohm cables.
5. Field customizable multi-port frame capable of expanding to six connections.

D. Wall Plates

1. Listed to UL 514C, CSA C22.2 #42.1-00
2. Provide an adapter plate for proper device alignment and wall plate attachment.
3. Wall plate styles and colors to be provided as defined on the project drawings and schedules.

**2.16 SOURCE QUALITY CONTROL**

- A. Perform full-function testing on all completed assemblies at end of line. Statistical sampling is not acceptable.
- B. Audit burn-in at 40 degrees C (104 degrees F) ambient temperature of dimming assemblies and panels at full load for two hours.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install equipment in accordance with manufacturer's installation instructions.
- B. Provide complete installation of system in accordance with Contract Documents.
- C. Provide dedicated network between System computer and Lighting Management Panels.
- D. Provide equipment at locations and in quantities indicated on Drawings. Provide any additional equipment required to provide control intent.
- E. Define each dimmer's/relay's load type, assign each load to a zone, and set control functions.
- F. Mount exterior daylight sensors to point due north with constant view of daylight.
- G. Ensure that daylight sensor placement minimizes sensors view of electric light sources; ceiling mounted and fixture-mounted daylight sensors shall not have direct view of luminaries.
- H. Systems Integration:
  - 1. Equipment Integration Meeting Visit
    - a. Facility Representative to coordinate meeting between Facility Representative, Lighting Control System Manufacturer and other related equipment manufacturers to discuss equipment and integration procedures.

#### **3.2 SERVICE AND SUPPORT**

- A. Startup and Programming
  - 1. Provide factory certified field service engineer to make minimum of three site visits to ensure proper system installation and operation under following parameters
    - a. Qualifications for factory certified field service engineer:
      - 1) Minimum experience of 2 years training in the electrical/electronic field.
      - 2) Certified by the equipment manufacturer on the system installed.
    - b. Make first visit prior to installation of wiring. Review:
      - 1) Low voltage wiring requirements.
      - 2) Separation of power and low voltage/data wiring.
      - 3) Wire labeling.
      - 4) Lighting Management Panel locations and installations.
      - 5) Control locations.

- 6) Computer jack locations.
  - 7) Load circuit wiring.
  - 8) Network wiring requirements.
  - 9) Connections to other equipment and other lighting control equipment.
  - 10) Installer responsibilities.
  - 11) Power Panel locations.
  - c. Make second visit upon completion of installation of Network Lighting Control System:
    - 1) Verify connection of power wiring and load circuits.
    - 2) Verify connection and location of controls.
    - 3) Energize Lighting Management Panels and download system data program.
    - 4) Address devices.
    - 5) Verify proper connection of panel links (low voltage/data) and address panel.
    - 6) Download system panel data to dimming/switching panels
    - 7) Check dimming panel load types and currents and supervise removal of by-pass jumpers.
    - 8) Verify system operation control by control.
    - 9) Verify proper operation of manufacturers interfacing equipment.
    - 10) Verify proper operation of manufacturers supplied PC and installed programs.
    - 11) Configure initial groupings of ballast for wall controls, daylight sensors and occupant sensors.
    - 12) Initial calibration of sensors.
    - 13) Obtain sign-off on system functions.
  - d. Make third visit to demonstrate and educate Owner's representative on system capabilities, operation and maintenance.
2. Startup
    - a. System control configuration
      - 1) Naming and association of areas and lighting zones.
- B. Training of customer representatives for Control system.
    1. Configuration Software used to make system programming and configuration changes
    2. Control and Monitor
    3. Energy Management Equipment.
- C. Tech Support
    1. Provide factory direct technical support hotline 24 hours per day, 7 days per week.

**3.3 FIELD QUALITY CONTROL**

A. Manufacturer Services

1. Aim and Focus Visit
  - a. Facility Representative to coordinate on-site meeting with Lighting Control System Manufacturer and Lighting Design Consultant to make required lighting adjustments to the system for conformance with the Lighting Design Consultant's original design intent.

**3.4 CLOSEOUT ACTIVITIES**

A. Training Visit

1. Lighting Control System Manufacturer to provide 1 day additional on-site system training to site personnel.

B. On-site Walkthrough

1. Lighting Control System Manufacturer to provide a factory certified Field Service Engineer to demonstrate system functionality to the Commissioning Agent.

**3.5 MAINTENANCE**

A. Capable of providing on-site service support within 24 hours.

B. Offer renewable service contract on yearly basis, to include parts, factory labor, and annual training visits. Make service contracts available up to ten years after date of system startup.

C. System Optimization Visit.

1. Lighting Control System Manufacturer to visit site 6 months after system start-up to evaluate system usage and discuss opportunities to make efficiency improvements that will fit with the current use of the facility.

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**SECTION 26 27 13**

**ELECTRICITY METERING**

**PART 1-GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, complete installation, and connection of the electric meters for special loads.

**1.2 RELATED WORK**

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that is common to more than one section of Division 26.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Shop Drawings:
1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
  2. Include electrical ratings, dimensions, weights, mounting details and clearances required for servicing.
- C. Manuals: Two weeks prior to the final inspection, submit four copies of the following to the Resident Engineer:
1. Complete maintenance, operating and testing manuals including wiring diagrams, technical data sheets and information for ordering replacement parts:
- D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the Resident Engineer:
1. Certification by the manufacturer that the meter conforms to the requirements of the drawings and specifications, and the meter has been properly calibrated.
  2. Certification by the contractor that the meter has been properly installed, adjusted, and tested.

#### 1.4 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 the basic designation only.
- B. American National Standards Institute (ANSI):
1. C12.1-01                                Electric Meters Code for Electricity Metering
  2. C12.10-04                              American National Standard for Watt-hour Meters
- C. Institute of Electrical and Electronic Engineers (IEEE):
1. C37-90.1-02                            Standard Surge Withstand Capability (SWC) Tests  
for    Protection Relays and Relay Systems
- D. National Fire Protection Association (NFPA):
1. 70-05                                    National Electrical Code (NEC)
- E. Underwriters Laboratories, Inc. (UL):
1. 414-04                                  Standard for Safety Meter Sockets.

#### PART 2-PRODUCTS

##### 2.1 METERING EQUIPMENT FOR MAIN SWITCHBOARDS

- A. The equipment shall meter all of the single phase and three phase electrical service used by the equipment shown on the main switchboard drawings. No sub-metering is required.
- B. Polyphase watthour and recording demand:
1. Shall be microprocessor-based, Square D PML 850:
    - a. Microprocessor meters shall monitor the energy used on the ac systems 480/277 volts, 3 phase.
    - b. The unit shall be able to transmit information by twisted pair cable to a local network, Energy Control Center.
    - c. The unit shall be provided with three built-in doughnut type current transformers.
    - d. The unit shall display the following:
      - (1) Watts.
      - (2) Demand-Present.

- (3) Demand-Peak.
- (4) Watt-Hours.
- e. The unit shall be provided with an adjustable demand window of 15-minute intervals.
- f. All readings shall be adjustable from a remote location.
- g. Operating temperature range: -40 degrees F to 140 degrees F
- 2. Integrating demand intervals shall coincide with the power company's meter.
- 3. Multipliers shall be suitable for the sizes of the connected loads.

### **PART 3-EXECUTION**

#### **3.1 INSTALLATION**

- A. Installation shall be in accordance with the NEC, and as shown on the drawings.
- B. Install circuits and make connections as required for the metering equipment.

#### **3.2 DEMONSTRATION**

- A. At the final inspection in the presence of the VA representative, demonstrate that the electric meter operates properly in all respects.
  - 1. Test and adjust all controls and safeties. Replace or repair all malfunctioning controls, safeties, and equipment as soon as possible to avoid any delay in the use of the equipment.

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**SECTION 26 27 26**

**WIRING DEVICES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation and connection 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 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits and outlets boxes.
- C. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.
- D. 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.

**1.3 SUBMITTALS**

- A. In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:
- B. Shop Drawings:
1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
  2. Include electrical ratings, dimensions, mounting details, construction materials, grade and termination information.
- C. Manuals: Two weeks prior to final inspection, deliver four copies of the following to the Resident Engineer: Technical data sheets and information for ordering replacement units.
- D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the Resident Engineer: Certification by the Contractor that the devices comply with the drawings and specifications, and have been properly installed, aligned, and tested.

**1.4 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):
  - 1. 70-02 National Electrical Code (NEC)
- C. National Electrical Manufacturers Association (NEMA):
  - 1. WD 1-99 General Color Requirements for Wiring Devices
  - 2. WD 6-02 Wiring Devices - Dimensional Requirements
- D. Underwriter's Laboratories, Inc. (UL):
  - 1. 5-96 Surface Metal Raceways and Fittings
  - 2. 20-00 General-Use Snap Switches
  - 3. 231-98 Power Outlets
  - 4. 467-93 Grounding and Bonding Equipment
  - 5. 498-01 Attachment Plugs and Receptacles
  - 6. 943-03 Ground-Fault Circuit-Interrupters

## **PART 2 - PRODUCTS**

### **2.1 RECEPTACLES**

- A. General: All receptacles shall be listed by Underwriters Laboratories, Inc., as hospital grade (green dot identification) and conform to NEMA WD 1. (EXCEPTION - Receptacle types which have no listing as hospital grade but are listed by UL in their respective categories).
  - 1. Mounting straps shall be plated 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 min.) and side wiring from four captively held binding screws.
- B. Duplex receptacles shall be single phase, 20 ampere, 120 volts, 2-pole, 3-wire, and conform to the NEMA 5-20R configuration in NEMA WD 6. The duplex type shall have break-off feature for two-circuit operation. The ungrounded pole of each receptacle shall be provided with a separate terminal.
  - 1. Bodies shall be ivory in color.
  - 2. Switched duplex receptacles shall be wired so that only the top receptacle is switched. The remaining receptacle shall be unswitched.
  - 3. Duplex Receptacles on Emergency Circuit:
    - a. Bodies shall be red in color. Wall plates shall be red with the word "EMERGENCY" engraved in 6 mm, (1/4 inch) white letters.
    - b. In rooms without emergency powered general lighting, the emergency receptacles shall be of the self-illuminated type.

4. Ground Fault Interrupter Duplex Receptacles: Shall be an integral unit suitable for mounting in a standard outlet box.
    - a. Ground fault interrupter shall be hospital grade and consist of a differential current transformer, solid state sensing circuitry and a circuit interrupter switch. It shall be rated for operation on a 60 Hz, 120 volt, 20-ampere branch circuit. Device shall have nominal sensitivity to ground leakage current of five milliamperes and shall function to interrupt the current supply for any value of ground leakage current above five milliamperes (+ or - 1 milliamp) on the load side of the device. Device shall have a minimum nominal tripping time of 1/30th of a second. Devices shall meet UL 943.
  5. Safety Type Duplex Receptacles:
    - a. Bodies shall be gray in color.
    - b. Shall be hospital grade, as above with the following additional requirements.
      - (1) Shall permit current to flow only while a standard plug is in the proper position in the receptacle.
      - (2) Screws exposed while the wall plates are in place shall be the tamperproof type.
    - c. Shall be installed in the following locations:
      - (3) Psychiatric rooms and wards, O.T. areas, PMR areas and other locations where psychiatric patients are not under constant supervision.
      - (4) Housekeeping quarters, buildings, waiting areas and lobbies where children might be present.
  6. Duplex Receptacles (not hospital grade): Shall be the same as hospital grade duplex receptacles except for the "hospital grade" listing and as follows.
    - a. Bodies shall be brown phenolic compound supported by a plated steel mounting strap having plaster ears.
    - b. Shall be NEMA WD 1 heavy duty type.
- C. Receptacles; 20, 30 and 50 ampere, 250 volts: Shall be complete with appropriate cord grip plug. Devices shall meet UL 231.
- 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.

## 2.2 TOGGLE SWITCHES AND DIMMERS

- A. Toggle switches shall be totally enclosed tumbler type with bodies of phenolic compound. Toggle handles shall be ivory in color unless otherwise

specified. The rocker type switch is not acceptable and will not be approved.

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. Shall be color coded for current rating, listed by Underwriters Laboratories, Inc., and meet the requirements of NEMA WD 1, Heavy-Duty and UL 20.
  4. Ratings:
    - a. 120 volt circuits: 20 amperes at 120-277 volts AC.
    - b. 277 volt circuits: 20 amperes at 120-277 volts AC.
  5. The switches shall be mounted on the striker plate side of doors.
  6. Incorporate barriers between switches with multigang outlet boxes where required by the NEC.
  7. All toggle switches shall be of the same manufacturer.
- B. Dimmers: Incandescent modular dimming systems.
- C. Dimmers: Fluorescent lamp loads. Wall-mounted fluorescent lamp dimmers shall be specification grade with large control knob and shall be capable of raising and lowering the lighting from completely off at extreme counter-clockwise rotation, to full intensity. Dimmers shall include an "off" position. Dimmers shall have low end intensity adjustment and maintain full load rating even when two or more units are installed adjacent to one another. All wall-mounted dimmers shall be of the same manufacturer. Dimming ballast shall be provided for each F32 rapid start lamp or pair of lamps. Dimmers shall have adequate capacity for the load served and the environment in which installed.

### 2.3 WALL PLATES

- A. Wall plates for switches and receptacles shall be type 302 stainless steel for food area and utility places where subject to physical damage and smooth nylon the other area. Oversize plates are not acceptable.
- B. Color shall be ivory for plastic plates unless otherwise specified.
- C. Standard NEMA design, so that products of different manufacturers will be interchangeable. Dimensions for openings in wall plates shall be accordance with NEMA WD1.
- D. For receptacles or switches mounted adjacent to each other, wall plates shall be common for each group of receptacles or switches.
- E. In psychiatric areas, wall plates shall have tamperproof screws and beveled edges.

- F. Wall plates for data, telephone or other communication outlets shall be as specified in the associated specification.

#### **2.4 SURFACE MULTIPLE-OUTLET ASSEMBLIES**

- A. Assemblies shall conform to the requirements of NFPA 70 and UL 5.
- B. Shall have the following features:
  - 1. Enclosures:
    - a. Thickness of steel shall be not less than 1 mm (0.040 inch) steel for base and cover. Nominal dimension shall be 40 by 70 mm (1-1/2 by 2-3/4 inches) with inside cross sectional area not less than 2250 square mm (3.5 square inches). The enclosures shall be thoroughly cleaned, phosphatized and painted at the factory with primer and the manufacturer's standard baked enamel or lacquer 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, spacing of the receptacles along the strip shall be 600 mm (24 inches) on centers.
  - 4. Wires within the assemblies shall be not less than No. 12 AWG copper, with 600 volt ratings.
  - 5. Installation fittings shall be designed for the strips being installed including bends, offsets, device brackets, inside couplings, wire clips, and elbows.
  - 6. Bond the strips to the conduit systems for their branch supply circuits.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Installation shall be in accordance with the NEC and as shown as on the drawings.
- B. Ground terminal of each receptacle shall be bonded to the outlet box with an approved green bonding jumper, and also connected to the green equipment grounding conductor.

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**SECTION 26 29 21**

**DISCONNECT SWITCHES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation and connection of low voltage disconnect switches.

**1.2 RELATED WORK**

- A. General electrical requirements and items that is common to more than one section of Division 26: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Conduits for cables and wiring: Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
- C. Cables and wiring: Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).
- D. Motor rated toggle switches: Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.
- E. Requirements for personnel safety and to provide a low impedance path for possible ground faults: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Shop Drawings:
1. Include sufficient information, clearly presented to determine compliance with drawings and specifications.
  2. Include electrical ratings, dimensions, mounting details, materials, enclosure types, fuse type and class.
  3. Show the specific switch and fuse proposed for each specific piece of equipment or circuit.
- C. Manuals:
1. Provide complete maintenance and operating manuals for disconnect switches, including technical data sheets, wiring diagrams, and information for ordering replacement parts. Deliver four copies to the Resident Engineer two weeks prior to final inspection.
  2. Identify terminals on wiring diagrams to facilitate maintenance and operation.
  3. Wiring diagrams shall indicate internal wiring and any interlocking.



- D. Certification: Two weeks prior to final inspection, deliver to the Resident Engineer four copies of the certification that the equipment has been properly installed, adjusted, and tested.

#### 1.4 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 the basic designation only.
- B. National Electrical Manufacturers Association (NEMA):
1. KS 1-01 Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
- C. National Fire Protection Association (NFPA):
1. 70-05 National Electrical Code (NEC)
- D. Underwriters Laboratories, Inc. (UL):
1. 98-98 Enclosed and Dead-Front Switches
  2. 198C-89 High-Interrupting-Capacity Fuses, Current Limiting Types
  3. 198E-94 Class R Fuses
  4. 977-99 Fused Power-Circuit Devices

## PART 2 - PRODUCTS

### 2.1 LOW VOLTAGE FUSIBLE SWITCHES RATED 600 AMPERES AND LESS

- A. Shall be quick-make, quick-break type in accordance with UL 98, NEMA KS 1 and NEC.
- B. Shall have a minimum duty rating, NEMA classification Heavy Duty for 240 volts and NEMA classification Heavy Duty (HD) for 277/480 volts.
- C. Shall be horsepower rated.
- D. Shall have the following features:
1. Switch mechanism shall be the quick-make, quick-break type.
  2. Copper blades, visible in the OFF position.
  3. An arc chute for each pole.
  4. External operating handle shall indicate ON and OFF position and shall have lock-open padlocking provisions.
  5. Mechanical interlock shall permit opening of the door only when the switch is in the OFF position, defeatable by a special tool to permit inspection.
  6. Fuse holders for the sizes and types of fuses specified.

7. Electrically operated switches shall only be installed where required.
8. Solid neutral for each switch being installed in a circuit which includes a neutral conductor.
9. Ground Lugs: One for each ground conductor.
10. Enclosures:
  - a. Shall be the NEMA types shown on the drawings for the switches.
  - b. Where the types of switch enclosures are not shown, they shall be the NEMA types which are most suitable for the environmental conditions where the switches are being installed. Unless otherwise indicated on the plans, all outdoor switches shall be NEMA 3R.
  - c. Shall be finished with manufacturer's standard gray baked enamel paint over pretreated steel (for the type of enclosure required).

**2.2 LOW VOLTAGE UNFUSED SWITCHES RATED 600 AMPERES AND LESS**

- A. Shall be the same as Low Voltage Fusible Switches Rated 600 Amperes and Less, but no fuses.

**2.3 MOTOR RATED TOGGLE SWITCHES**

- A. Refer to Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS for motor rated toggle switches.

**2.4 IDENTIFICATION SIGNS**

- A. Install nameplate identification signs on each disconnect switch to identify the equipment controlled.
- B. Nameplates shall be laminated black phenolic resin with a white core, with engraved lettering, a minimum of 6 mm (1/4-inch) high. Secure nameplates with screws.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Install disconnect switches in accordance with the NEC and as shown on the drawings.
- B. Fusible disconnect switches shall be furnished complete with fuses.

**3.2 SPARE PARTS**

- A. Two weeks prior to the final inspection, furnish one complete set of spare fuses for each fusible disconnect switch installed on the project. Deliver the spare fuses to the Resident Engineer.

- - - E N D - - -



**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.

**1.2 RELATED WORK**

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General requirements that are common to more than one section of Division 26.
- B. Section 26 09 43, DIGITAL LIGHTING CONTROLS:
- C. Section 26 27 26, WIRING DEVICES: Wiring devices used as part of the lighting systems.
- D. 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.

**1.3 QUALITY ASSURANCE**

- A. Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Refer to Paragraph, GUARANTY, in Section 01 00 00, GENERAL CONDITIONS.

**1.4 SUBMITTALS**

- A. In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:
- B. Shop Drawings:
1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
  2. Include electrical ratings, dimensions, mounting details, materials, required clearances, terminations, wiring and connection diagrams, photometric data, ballasts, lenses, louvers, lamps, and controls.
  3. When catalog data and/or shop drawings for fluorescent fixtures are submitted for approval, photometric data from an independent testing laboratory shall be included with the submittal, indicating average brightness and efficiency of the fixture, as specified in specification or as shown on the drawings.

Coefficient of utilization data will not be considered a suitable substitute.

C. Samples:

1. Simultaneously with the shop drawing and catalog cut submittal, deliver to the Resident Engineer a sample of each lighting fixture types requested by resident engineer for approval. The approved samples shall be installed in the location directed by the Resident Engineer and shall be removed, repackaged and turned over to the Resident Engineer after final inspection.

D. Manuals:

1. Submit, simultaneously with the shop drawings companion copies of complete maintenance and operating manuals including technical data sheets, and information for ordering replacement parts.
2. Two weeks prior to the final inspection, submit four copies of the final updated maintenance and operating manuals, including any changes, to the Resident Engineer.

E. Certifications:

1. Two weeks prior to final inspection, submit four copies of the following certifications to the Resident Engineer:
  - a. Certification by the Contractor that the equipment has been properly installed, adjusted, and tested.
  - b. Include with shop drawings, certification from the manufacturers that all electronic high-frequency ballasts meet the transient protection required by IEEE C62.41, Cat. A. Include with initial shop drawing submittal.

### 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):

1. C78.1-91 Fluorescent Lamps - Rapid-Start Types - Dimensional and Electrical Characteristics
2. C78.2-91 Fluorescent Lamps - Preheat-Start Types - Dimensional and Electrical Characteristics
3. C78.3-91 Fluorescent Lamps - Instart Start and Cold-Cathode Types - Dimensional and Electrical Characteristics
4. C78.376-91 Chromaticity of Fluorescent Lamps (ANSI/NEMA C78/376-96)

C. Certified Ballast Manufacturers Association (CBM):

1. Requirements for Ballast Certification.

- D. Institute of Electrical and Electronic Engineers (IEEE):
  - 1. C62.41-91 Recommended Practice on Surge Voltage in Low Voltage AC Power Circuits
  
- E. National Fire Protection Association (NFPA):
  - 1. 70-05 National Electrical Code (NEC)
  - 2. 101-00 Life Safety Code
  
- F. National Electrical Manufacturer's Association (NEMA)
  - 1. C82.1-97 Ballasts for Fluorescent Lamps - Specifications
  - 2. C82.2-02 Method of Measurement of Fluorescent Lamp Ballasts
  - 3. Deleted
  - 4. C82.11-02 High Frequency Fluorescent Lamp Ballasts
  
- G. Underwriters Laboratories, Inc. (UL):
  - 1. 496-96 Edison-Base Lampholders
  - 2. 542-99 Lampholders, Starters, and Starter Holders for Fluorescent Lamps
  - 3. 844-95 Electric Lighting Fixtures for Use in Hazardous (Classified) Locations
  - 4. 924-95 Emergency Lighting and Power Equipment
  - 5. 935-01 Fluorescent-Lamp Ballasts
  - 6. 1029-94 High-Intensity-Discharge Lamp Ballasts
  - 7. 1598-00 Luminaires
  
- H. Federal Communications Commission (FCC):
  - 1. Code of Federal Regulations (CFR), Title 47, Part 18

## **PART 2 - PRODUCTS**

### **2.1 LIGHTING FIXTURES (LUMINAIRES)**

- A. Shall be in accordance with NFPA 70, UL 1598 and shall be 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. Where lighting fixtures are detailed with minimum 20 gauge housing, minimum 22 gauge housings will be acceptable provided

- they have strengthening embossed rib and break formations, which give the equivalent rigidity of a 20 gauge housing.
4. When installed, any exposed fixture housing surface, trim frame, door frame and lens frame shall be free of light leaks; lens doors shall close in a light tight manner.
  5. Hinged door closure frames shall operate smoothly without binding when the fixture is in the installed position, and latches shall function easily by finger action without the use of tools.
- C. Ballasts shall be serviceable while the fixture is in its normally installed position, and shall not be mounted to removable reflectors or wireway covers unless so specified.
- D. Lamp Sockets:
1. Fluorescent: Lampholder contacts shall be the biting edge type or phosphorous-bronze with silver flash contact surface type and shall conform to the applicable requirements of UL 542. Contacts for recessed double contact lampholders and for slimline lampholders shall be silver plated. Lampholders for bi-pin lamps, with the exception of those for "U" type lamps, shall be of the telescoping compression type, or of the single slot entry type requiring a one-quarter turn of the lamp after insertion.
  2. Incandescent: Shall have porcelain enclosures and conform to the applicable requirements of UL 496.
  3. High Intensity Discharge (H.I.D.): Shall have porcelain enclosures.
- E. Recessed fluorescent fixtures mounted in an insulated ceiling shall be listed for use in insulated ceilings.
- F. Fluorescent fixtures with louvers or light transmitting panels shall have hinges, latches and safety catches to facilitate safe, convenient cleaning and relamping. Vapor tight fixtures shall have pressure clamping devices in lieu of the latches.
- G. Mechanical Safety: Lighting fixture closures (lens doors, trim frame, hinged housings, etc.) shall be retained in a secure manner by captive screws, chains, captive hinges or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.
- H. Metal Finishes:
1. The manufacturer shall apply his 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.

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.
- I. Provide all lighting fixtures with a specific means for grounding their metallic wireways and housings to an equipment grounding conductor.
- J. Light Transmitting Components for Fluorescent Fixtures:
1. Unless otherwise specified, shall be 100 percent virgin acrylic plastic or water white, annealed, crystal glass.
  2. Flat lens panels shall have not less than 3.2 mm (1/8 inch) of average thickness. The average thickness shall be determined by adding the maximum thickness to the minimum unpenetrated thickness and dividing the sum by 2.
  3. Unless otherwise specified, lenses, 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 of the lens without distortion or cracking.
- K. Lighting Fixtures in Hazardous Areas: Fixtures shall be suitable for installation in flammable atmospheres (Class and Group) as defined in NFPA 70 and shall comply with UL 844.
- L. Compact fluorescent fixtures shall be manufactured specifically for compact fluorescent lamps with ballasts integral to the fixture. Assemblies designed to retrofit incandescent fixtures are prohibited except when specifically indicated for renovation of existing fixtures. Fixtures shall be designed for lamps as specified.

## 2.2 FLUORESCENT LAMP BALLASTS

- A. Where applicable, fluorescent lamps and ballasts shall comply with the National Energy Policy Act of 1992.
- B. Ballasts shall comply with NEMA 82.1, 82.2 and 82.11, NFPA 70, UL 924 and UL 935 unless otherwise specified.
- C. Lamp types F14T5, F28T5 and F54T5 F32T8 and F32T8/U shall be operated by electronic, high frequency ballasts. All other fluorescent lamp types shall be operated by the standard energy saving electromagnetic core-and-coil ballasts. For these applications, the lamps shall be operated by core-and-coil ballasts where specifically required on the drawings as "core-and-coil".
- D. All fluorescent Ballasts shall be compatible with the lighting control system. See section 260943.
- E. Electronic high-frequency ballasts:
1. Ballasts shall operate the lamps at a frequency between 20 and 60 KHz from an input frequency of 60Hz.



2. Ballast package:
  - a. Size: The ballast case shall be sized to be physically interchangeable with standard core-and-coil ballasts and suitable for standard mounting in new or existing lighting fixtures.
  - b. Case marking: Mark the ballast to indicate the required supply voltage, frequency, RMS current, current surge during starting, input watts, and power factor at the design center voltage, open circuit voltage, crest factor and efficacy.
3. Performance:
  - a. Light output:
    - 1) At the design voltage, the light output shall be at least equal to that obtained by a core-and-coil ballasted system meeting ANSI, NEMA and CBM standards. The comparison test shall be measured in the same fixture at 25 degrees C (plus or minus one degree) ambient room temperature.
    - 2) Tests shall be made in fixtures designed only for the number of lamps being tested.
    - 3) For other applications (higher ambients, etc.) the tests should be operated with equivalent lamp wall temperatures plus or minus 4 degrees C.
  - b. Efficacy: The efficacy of the high-frequency, electronically ballasted system shall be at least 15 percent greater than the equivalent CBM core-and-coil ballasted system (see "Light output" above).
  - c. Starting: The ballast shall be capable of starting and maintaining operation of lamps at an ambient temperature of 10 degrees C (50 degree F) or more for an input voltage of plus or minus 10 percent about the center design voltage unless otherwise indicated. The ballast shall never be started in the instant start mode at any temperature.
  - d. Operation:
    - 1) The ballast shall safely and reliably operate in a room ambient temperature from 10 degrees C (50 degree F) to 40 degrees C (105 degree F).
    - 2) The light output shall not vary by more than plus or minus 5 percent for a plus or minus 10 percent variation of the input voltage about the center design voltage. Light output shall remain constant for a plus or minus 5 percent variation of the input voltage.
    - 3) The ballast shall operate the lamps in a manner that will not adversely curtail the normal life of the lamp.
  - e. Transient protection: The ballast shall comply with IEEE C62.41, Cat. A.
  - f. Flicker: The flicker shall be less than 5 percent and without visible flicker.
  - g. Noise: The audible noise levels should be equivalent to or better than the Class A rating of CBM certified ballasts.
  - h. Electromagnetic Interference (EMI) and Radio Frequency Interference (RFI): The EMI and RFI limits shall meet the

- requirements of the Federal Communications Commission Rules and Regulations (CFR 47 Part 18).
  - i. Rated life: The ballast shall have a rated life of 10 years or 30,000 hours (based on a 10 hour day).
  - j. The two-lamp ballast shall safely operate two F32T8 RS, 32-watt lamps or two F32T8/U lamps. The single lamp ballast shall safely operate one F32T8 RS, 32-watt lamp or one F32T8/U lamp.
  - k. Power factor: Not less than 95 percent.
  - l. Reliability:
    - 1) Labels: Ballasts must be labeled or listed by UL and CBM/ETL.
    - 2) Submit, simultaneously with shop drawings, a certified test report by an independent testing laboratory showing that the electronic ballasts meet or exceed all the performance requirements in this specification.
  - m. Total harmonic distortion (THD) shall be less than 10 percent.
- F. Core-and-coil ballasts (for lamps other than F32T8 and F32T8/U or where shown on drawings as "core-and-coil"):
- 1. Shall be rapid starting type.
  - 2. Shall comply with NEMA 82.1 and UL 935.
  - 3. Shall be UL Class P with automatic-resetting, internal, thermal protection.
  - 4. Shall be CBM/ETL certified.
  - 5. Power factor shall be not less than 95 percent. Capacitors in ballasts shall not contain PCB (Polychlorinated Biphenyl) fluids or other fluids recognized as hazardous when discharged into the environment.
  - 6. Sound ratings shall be Class A or better, except for ballast sizes which are not available with Class A ratings, as standard products from any manufacturer. Ballasts which are not available with Class A ratings shall have the quietest ratings available.
  - 7. Where core-and-coil ballasts are specified or detailed in lieu of the normally required electronic high-frequency types, two lamp ballasts shall be energy-saving type, UL listed to operate F32T8, F28T5, F54T5 rapid start lamps for both standard 28, 32, 54 watt lamps. Lamp output shall be within 5 percent of nominal rating. Energy-saving type ballasts should not be used in ambient temperatures below manufacturer's recommendations.
- G. Ballasts for lighting fixtures controlled by dimming devices shall be the electronic, high frequency type as specified herein, equipped for dimming and conform to the recommendations of the manufacturer of the associated dimming devices to assure satisfactory operation of the lighting system.

- H. All ballasts serving straight or "U" type lamps shall be mounted by four non-turning studs (or captive bolts) equipped with lock washers and nuts or locking type nuts, or by four thread cutting (TC) sheet metal screws which are firmly secured against the fixture body (or wireway) to maximize dissipation of heat and minimize noise. Exception: electronic high-frequency ballasts may be mounted at a minimum of two points, one at each end of unit.
- I. Ballasts shall be serviceable while the fixture is in its normally installed position, and shall not be mounted to removable reflectors or wireway covers unless so specified.
- J. 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.
- K. Deleted

**2.3 Deleted**

**2.4 LAMPS**

- A. Fluorescent Lamps:
  - 1. Rapid start fluorescent lamps shall comply with ANSI C78.1; preheat-start type shall comply with ANSI C78.2; and instant-start and cold-cathode lamps shall comply with ANSI C78.3.
  - 2. Chromacity of fluorescent lamps shall comply with ANSI C78.376.
  - 3. The lamps shall include the F32T8, F32T8/U 32 watt energy saving type and EPACT approved F28T5 and F54T5 type if specifically required by contract drawings.
  - 4. Mercury shall be of low content.
  - 5. Except as indicated below, lamps shall be energy saving type, have a color temperature between 3500 and 4100°K, a Color Rendering Index (CRI) of not less than 80, and an initial lumen output not less than 2800. "U" tube lamps shall have the same color temperature and CRI limits as the above.
    - a. In utility areas (Electrical, Communication and Mechanical) Service rooms and closets), maintenance closets and non-medical storage spaces, utilize energy saving light-white lamps.
    - b. In areas with ambient temperatures below 60 degrees use the 40 watt version of the lamp above.
    - c. Over the beds in Intensive Care, Coronary Care, Recovery, Life Support, and Observation and Treatment areas; Electromyographic, Autopsy (Necropsy), Surgery, and certain dental rooms (Examination, Oral Hygiene, Oral Surgery, Recovery, Labs, Treatment, and X-Ray) use color corrected

lamps having a CRI of 90 or above and a correlated color temperature between 5000 and 6000°K.

d. Other areas as indicated on the drawings.

B. Deleted

C. Deleted

D. Compact Fluorescent Lamps: Shall be 4100°K, 10,000 hours average rated life, and as follows:

1. T4, twin tube, rated 13 watts, 825 initial lumens minimum
2. T4, double twin tube rated 26 watts, 1800 initial lumens minimum

## 2.5 OCCUPANT SENSOR LIGHTING CONTROL SYSTEMS

A. Deleted

B. Deleted

C. Deleted

D. GENERAL

1. The following statement ensures a single point of contact for system operation. Some interaction between hardware and software requires a high level of integration and compatibility.
2. Provide system software and hardware that is designed, tested, manufactured, and warranted by a single manufacturer.
3. Typical dimming equipment is rated for 40 degrees C (104 degrees F). This is the maximum ambient temperature that can exist while the dimming equipment is operating at full load conditions. The following statement ensures that the operating equipment is designed to operate at worst case environmental conditions without affecting product life.
4. Architectural Lighting Controls: Ten-year operational life while operating continually at any temperature in an ambient temperature range of 0 degrees C (32 degrees F) to 40 degrees C (104 degrees F) and 90 percent non-condensing relative humidity.
5. Electrostatic charge builds up on people as a result of friction (walking across a carpet). When a person touches an electronic device, a discharge can occur and cause damage. Electrostatic Discharge (ESD) testing is done according to the IEC 801-2 standard (human body model). Testing should be completed on all user accessible points such as terminal blocks, buttons, and control inputs. The standard listed below describe only how to conduct this test, that is why it is important to specify "without impairment of performance" as the pass/fail criteria.
6. Designed and tested to withstand discharges without impairment of performance when subjected to discharges of 15,000 volts per IEC 801-2.

E. SENSOR PERFORMANCE REQUIREMENTS

1. Sensing mechanism:
  - a. Dual technology:
2. Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
3. Utilize an operating frequency of 32kHz or 40kHz that shall be crystal controlled to operate within plus or minus 0.005 percent tolerance.
4. Field adjustable controls for time delay and sensitivity to override any adaptive features.
5. Power failure memory:
  - a. Controls incorporate non-volatile memory. Should power be interrupted and subsequently restored, settings and learned parameters saved in protected memory shall not be lost.
6. Designed and tested to withstand discharges without impairment of performance when subjected to discharges of 15,000 volts per IEC 801-2.

F. WIRED CEILING SENSORS

1. Provide all necessary mounting hardware and instructions.
2. Sensors shall be Class 2 devices.
3. Indicate viewing directions on mounting bracket for all Ceiling mount sensors.
4. Provide customizable mask to block off unwanted viewing areas for all ceiling mounted sensors using infrared technology.
5. Provide swivel mount base for all wall mount sensors.
6. Provide an internal additional isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC control, Data Logging and other control options.

G. MOUNTING:

1. Provide surface mounting bracket compatible with drywall, plaster, wood, concrete, compressed fiber ceilings.
2. Provide all necessary mounting hardware and instructions for both temporary and permanent mounting.
3. Provide temporary mounting means to allow user to check proper performance and relocate as needed before permanently mounting sensor. Temporary mounting method shall be designed for easy, damage-free removal.
4. Ceiling-mount wireless occupancy/vacancy sensors using passive infrared technology shall have a customizable mask to block off unwanted viewing areas.
5. Sensor lens shall illuminate during test mode when motion is detected to allow installer to verify coverage prior to permanent mounting.

6. A vacancy-only model shall be available to meet California Title 24 Energy Efficiency Standard requirements.

#### **2.6 SENSOR POWER PACKS**

- A. Plenum rated and non plenum per installed location.
- B. Control wiring between sensors and control units shall be Class 2, 18-24 AWG, stranded U.L. Classified, PVC insulated or TEFLON jacketed cable suitable for use in plenums.
- C. Integrated, self-contained unit consisting internally of an isolated load switching control relay and a power supply to provide low-voltage power when connected to a low voltage device or controller.

#### **2.7 SOURCE QUALITY CONTROL**

- A. Perform full-function testing on 100 percent of all system components and panel assemblies at the factory.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install equipment in accordance with manufacturer's installation instructions.
- B. Provide complete installation of system in accordance with Contract Documents.
- C. Provide any additional equipment required to provide control intent.

#### **3.2 SERVICE AND SUPPORT**

- A. Startup and Programming
  1. Provide factory-certified field service engineer to a site visit to ensure proper system installation and operation under following parameters:
  2. Qualifications for factory-certified field service engineer:
    - a. Minimum experience of 2 years training in the electrical/electronic field.
    - b. Certified by the equipment manufacturer on the system installed.
  3. Make a visit upon completion of installation of lighting control system:
    - a. Verify connection and location of controls.
    - b. Verify system operation control by control, zone by zone.
    - c. Verify proper integration of manufacturers interfacing equipment.
    - d. Obtain sign-off on system functions.

B. Tech Support

1. Provide factory direct technical support hotline 24 hours per day, 7 days per week.

**3.3 MAINTENANCE**

A. Capable of providing on-site service support within 24 hours anywhere in continental United States and within 72 hours worldwide except where special visas are required.

B. Offer renewable service contract on yearly basis, to include parts, factory labor, and annual training visits. Make service contracts available up to ten years after date of system startup.

C. Dual Technology Wall sensor: Sensor shall be capable of detecting presence in the control area by detecting Doppler shifts in transmitted ultrasound and passive infrared (PIR) heat changes.

1. Sensor shall utilize Dual Sensing Verification Principle for coordination between ultrasonic and PIR technologies to reduce likelihood of false operations.
2. For best results, sensor shall feature a trigger mode where the end-user can choose which technology will activate the sensor from off mode (initial), the type of detection that will reset the time delay (maintain), and the type of detection that will cause the sensor to be turned back on immediately after lights turned off due to lack of motion (re-trigger). Selection of technologies for initial, maintain, and re-trigger shall be done with DIP switches. Contractor to set each sensor in optimum configuration based upon manufacturers recommendations for each installation.
3. Sensor shall have its trigger mode factory preset to allow for quick installation in most applications. In this default setting, both technologies must occur in order to initially activate lighting systems. Detection by either technology shall maintain lighting on, and detection by either technology shall turn lights back on after lights were turned off for five seconds or less in automatic mode and 30 seconds or less in manual mode.
4. Sensor shall have four occupancy logic options for customized control to meet application needs.
5. Robotic test method as referred in the NEMA WD 7 guide shall be utilized for minor motion coverage verification.
6. Ultrasonic sensing shall be volumetric in coverage with a frequency of 40 KHz. It shall utilize Advanced Signal Processing which automatically adjusts the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout controlled space.
7. The PIR technology shall utilize a temperature compensated, dual element sensor and a multi-element Fresnel lens. The lens shall be Poly IR4 material to offer superior performance in the infrared wavelengths and filter short wavelength IR, such as

those emitted by the sun and other visible light sources. The lens shall have grooves facing in to avoid dust and residue build up which affects IR reception.

8. Sensor shall utilize logic operations technology to optimize automatic time delay to fit occupant usage patterns. The use of variable associated with logic operations shall be selectable with a DIP switch.
  9. Sensor shall utilize Zero Crossing circuitry to reduce stress on relay and therefore increase sensor life.
  10. The sensor shall have no minimum load requirement and shall be capable of switching from 0 to 800 Watt incandescent; 0 to 800 Watt fluorescent or 1/6 hp @ 120 VAC, 50/60Hz; and 0 to 1200 Watt fluorescent @ 230/277 VAC, 50/60Hz.
  11. DW-100-347 sensor shall have no minimum load requirement and shall be capable of switching from 0 to 1500 Watt fluorescent @ 347 VAC, 50/60Hz.
- D. Timing/Function: Shall not be user adjustable. Lighting shall remain on with one or more persons within the covered area. The system shall be factory set to maintain lights on for a minimum of 8 minutes and not longer than 12 minutes after the area of coverage is vacated. For testing purposes, there shall be a means to change the pre-set time delay to 30 seconds or less.
- E. Control Unit: The system shall have a switching relay(s) capable of switching the fluorescent or incandescent loads as required. Contacts shall be rated at a minimum of 15 Amps at voltages to 277, with expected cycles of operation in excess of 100K. Power derived from a current limiting 24 volt transformer shall power the system and the unit must be packaged for installation on a standard 200 mm x 200 mm (4 inch x 4 inch) NEMA box enclosure. The unit shall be wired through a conventional wall switch to provide an over-ride system "Off" and active "Off-On" functioning.
- F. Field Wiring: The wiring between the control unit and sensor(s) shall be an insulated multi-conductor, #22 gauge Poly Vinyl Chloride (PVC) jacketed cable.
- 3.4 REMOTE CONTROL SWITCHING FOR INDOOR LIGHTING SYSTEMS**
- A. Shall be rated for continuous-duty service.
  - B. Electric contacts shall be precious metal surface.
  - C. Magnetic contactors and relays shall be electrically-operated and mechanically-held.
  - D. Characteristics of the components and the total resistances of the circuits throughout the systems shall be such that the systems will operate satisfactorily in every respect while the branch circuit power supply voltage to each system is within a 105-130 volt range at 60 Hz.



- E. Wall switches shall be the momentary contact type suitable for mounting in a single gang outlet box space and compatible with the standard design wall plates as specified.
- F. Where shown on the drawings, incorporate the components in panelboards behind separate doors and mount them on sound absorbing materials.
- G. Install circuit breaker or fuse protection for the control circuits.
- H. Low voltage remote control system shall be DC type, operating at not greater than 30 volts, and meeting the requirements for Class 2 circuits in Article 725 of the NEC.
- I. See also 260943.

### 3.5 RADIO-INTERFERENCE-FREE FLUORESCENT FIXTURES

- A. Shall be specially designed for suppressing radio-frequency energy produced within the fixtures. The Rules and Regulations of FCC (CFR 47, Part 18) shall apply.
- B. Lenses shall have a light-transparent layer of metal permanently bonded to them, and in positive contact with the steel housing or equal to prevent the radio-frequency interferences from passing through the lenses. The effective light transmittance of the lenses shall be not less than 75 percent.
- C. Install line filters within the body of the fixtures and wired in series with the supply circuit conductors to eliminate the transmission of radio frequency energy into the supply circuit.

### 3.6 FLUORESCENT BEDLIGHT FIXTURES

- A. Requirements:
  - 1. Fixed or movable arms are not acceptable.
  - 2. Exposed surfaces shall remain cool to the touch.
  - 3. Major portion of the light shall be directed upwards and outwards through lenses. Balance of the light shall be directed downwards through lenses to produce low brightness surfaces with minimum contrast as viewed by the patients from their normal viewing angles in bed.
  - 4. Shall provide not less than 110 lx (10 footcandles) (average) of general room illumination measured 750 mm (30 inches) above the floor.
  - 5. Shall provide 330 lx (30 footcandles) on the reading surfaces for the patients while in a normal prone or normal sit-up position in bed.
- B. Provide, pull cord switch on the fluorescent bedlight (ambient/reading) within easy reach of the patient while in a normal prone position in bed. The switches shall enable the patient to control the upward and downward portion of the light separately and

simultaneously, to include an off position, except in single bed rooms where the switch shall enable the patient to energize and de-energize the downward light only. In the single bed rooms, provide a 2-position pull cord switch for "on-off" control of the downward lamps.

C. Deleted

### 3.7 Deleted

### 3.8 EXIT LIGHT FIXTURES

A. Exit light fixtures shall meet applicable requirements of NFPA 101 and UL 924.

B. Housing and Canopy:

1. Shall be made of cast or extruded aluminum, or rolled steel.
2. Optional steel housing shall be a minimum 20 gauge thick or equivalent strength aluminum.
3. Steel housing shall have baked enamel over corrosion resistant, matte black or ivory white primer.
4. Fiberglass housing shall be used in corrosive environments.

C. Door frame shall be cast or extruded aluminum, and hinged with latch.

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 red Light Emitting Diodes (LED) mounted in center of letters on red color stable plastic or fiberglass. The LED shall be rated minimum 25 years life; maximum of 3.5 watts for single face and 7 watts for double-faced fixtures that do not use diffuser panels in front of the LEDs. LED exit light fixtures that use diffuser panels shall require a maximum of 1.0 watt per fixture for single or double face fixtures.
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. Voltages: Fluorescent fixtures shall be wired for typical 277-volt operation.

#### **PART 4 - EXECUTION**

##### **4.1 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. Avoid interference with and provide clearance for equipment. Where the indicated locations for the lighting fixtures conflict with the locations for equipment, change the locations for the lighting fixtures by the minimum distances necessary as approved by the Resident Engineer.
- D. For suspended lighting fixtures, the mounting heights shall provide the clearances between the bottoms of the fixtures and the finished floors as shown on the drawings.
- E. Deleted
- F. 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. Note: Ceiling types are defined in ASTM Standard C635-69.

- 1) Where fixtures mounted in "Intermediate" and "Heavy Duty" ceilings 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 (1/4-20) 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 600 mm x 600 mm (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 pendent-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.
- G. Furnish and install the specified lamps for all lighting fixtures installed and all existing lighting fixtures reinstalled under this project.
- H. Coordinate between the electrical and ceiling trades to ascertain that approved lighting fixtures are furnished in the proper sizes and installed with the proper devices (hangers, clips, trim frames, flanges), to match the ceiling system being installed.
- I. Bond lighting fixtures and metal accessories to the grounding system as specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- J. At completion of project, relamp all fixtures which have failed/burned-out lamps. Clean all fixtures, lenses, diffusers and louvers that have accumulated dust/dirt during construction.

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**SECTION 27 05 11**

**REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. This Section includes general administrative and procedural requirements for Division 27, and is intended to supplement, not supersede, the requirements specified in Division 01.
- B. The requirements described herein include the following:
  - 1. References
  - 2. Definitions
  - 3. System Description and Existing Conditions
  - 4. Submittals
  - 5. Quality Assurance
  - 6. Delivery, Storage, and Handling
  - 7. Scheduling
  - 8. Warranty
  - 9. Project Management and Coordination Services
  - 10. Field Quality Control
  - 11. Project Closeout and Record Documents
- C. Related Items
  - 1. General and Supplementary Conditions: General provisions of Contract and Division 01 apply to Division 27.
  - 2. Consult other Divisions and Sections, determine the extent and character of related work, and coordinate Work of Division 27 with that specified elsewhere to produce a complete and operable installation.
  - 3. Section 270526 - Grounding and Bonding for Communications Systems
  - 4. Section 270543 - Underground Ducts and Raceways for Communications
  - 5. Section 270811 - Testing for Communications
  - 6. Section 271100 - Communications Equipment Room Fittings
  - 7. Section 271314 - Communication Backbone OSP Twisted Pair Cabling
  - 8. Section 271324 - Communication Backbone OSP Fiber Cabling
  - 9. Section 271500 - Communications Horizontal Cabling
  - 10. Section 271523 - Communications Horizontal Fiber Cabling

**1.2 REFERENCES**

- A. General
  - 1. Codes, standards, and industry manuals/guidelines listed by reference, including revisions by issuing authority, form a part of this

- specification section to extent indicated. Consider such codes and/or standards a part of this Specification as though fully repeated herein.
2. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.
  3. Reference to codes, standards, specifications and recommendations of technical societies, trade organizations and governmental agencies shall mean that latest edition of such publications adopted and published prior to submittal of the bid unless otherwise specifically stated.
- B. Codes: Perform Work and furnish materials and equipment under Division 27 in accordance with applicable requirements of the latest edition of governing codes, rules and regulations including but not limited to the following minimum standards, whether statutory or not:
1. United States Department Of Labor (DOL) Regulations (Standards - 29 CFR)
    - a. Part 1910, "Occupational Safety and Health Standards"
  2. National Fire Protection Agency (NFPA)
    - a. NFPA 70, "National Electrical Code" (NEC)
    - b. NFPA 75, "Protection Of Information Technology Equipment"
    - c. NFPA 255, "Standard Method of Test of Surface Burning Characteristics of Building Materials", 2006
    - d. NFPA 259, "Standard Test Method for Potential Heat of Building Materials", 2003
  3. California Code of Regulations (CCR) Title 24, California Building Standards Code Part 2, Basic Building Regulations and Part 3, California Electrical Code (CEC)
  4. Uniform Building Code (UBC)
  5. Uniform Fire Code (UFC)
  6. Uniform Mechanical Code (UMC)
  7. National, State, Local and other binding building and fire codes
  8. Federal Communications Commission (FCC) Title 47 of the Code of Federal Regulations (CFR):
    - a. Part 15 - Radio Frequency Devices & Radiation Limits
    - b. Part 24 - Personal Communications Services
    - c. Part 27 - Miscellaneous Wireless Communications Services
    - d. Part 68 - Connection of Terminal Equipment to the Telephone Network
- C. Standards: Perform Work and furnish materials and equipment under Division 27 in accordance with the latest editions of the following standards as applicable:
1. Underwriter's Laboratories (UL): Applicable listing and ratings, including but not limited to the following standards:
    - a. UL 444: Communications Cables

- b. UL 497: Protectors for Paired-Conductor Communication Circuits
  - c. UL 1651: Optical Fiber Cable
  - d. UL1655: Community-Antenna Television Cables
  - e. UL 1690: Data-Processing Cable
  - f. UL 1963: Communications-Circuit Accessories
  - g. UL 2024A: Optical Fiber Cable Routing Assemblies
- 2. ANSI/TIA/EIA-568-B Commercial Building Telecommunications Cabling Standard
    - a. Part 1: General Requirements
    - b. Part 2: Balanced Twisted-Pair Cabling Components
    - c. Part 2, Addendum 1 (ANSI/TIA/EIA-568-B.2-1): Transmission Performance Specifications For 4-Pair 100 Ohm Category 6 Cable
    - d. Part 2, Addendum 10 (ANSI/TIA/EIA-568-B.2-10): Transmission Performance Specifications for 4 Pair 100 Ohm Augmented Category 6 Cabling
    - e. Part 3: Optical Fiber Cabling Components Standard
  - 3. ANSI/TIA/EIA-569-A Commercial Building Standard for Telecommunications Pathways and Spaces, including the following addenda:
    - a. TIA/EIA-569-A-1 Perimeter Pathway Addendum
    - b. TIA/EIA-569-A-2 Furniture Pathways Fill Addendum
    - c. TIA/EIA-569-A-3 Access Floors
    - d. TIA/EIA-569-A-4 Poke-Thru Devices
    - e. TIA/EIA-569-A-6 Multi-Tenant Pathways and Spaces
    - f. TIA/EIA-569-A-7 Cable Trays and Wireways
  - 4. ANSI/TIA/EIA-598-B Optical Fiber Cable Color Coding
  - 5. ANSI/TIA/EIA-606-A Administration Standard for Commercial Telecommunications Infrastructure
  - 6. ANSI/J-STD-607-A Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
  - 7. ANSI/TIA/EIA-758 Customer-Owner Outside Plant Telecommunications Cabling Standard
    - a. TIA/EIA-758-1 Addendum No. 1
  - 8. EIA testing standards
  - 9. Insulated Cable Engineers Association (ICEA):
    - a. ANSI/ICEA S-80-576-2002 Category 1 & 2 Individually Unshielded Twisted Pair Indoor Cables for Use in Communications Wiring Systems
    - b. ANSI/ICEA S-83-596-1994 Fiber Optic Premises Distribution Cable
    - c. ANSI/ICEA S-87-640-1999 Fiber Optic Outside Plant Communications Cable



- d. ANSI/ICEA S-90-661-2002 Category 3, 5, & 5e Individually Unshielded Twisted Pair Indoor Cable for Use In General Purpose and LAN Communication Wiring Systems
- e. ICEA S-104-696-2001 Standard For Indoor-Outdoor Optical Cable
- 10. Building Industry Consulting Services International (BICSI):
  - a. Telecommunications Distribution Methods Manual (TDMM)
  - b. Customer-Owner Outside Plant Design Manual
  - c. Wireless Design Reference Manual (WDRM)
  - d. Network Design Reference Manual (NDRM)
- D. Make a copy of each document readily available during the course of construction for reference by field personnel.

### 1.3 DEFINITIONS

- A. The Definitions of Division 01 shall apply to Division 27 sections.
- B. In addition to those Definitions of Division 01, the following list of terms as used in this specification defined as follows:
  - 1. "As directed": As directed or instructed by the Owner, or their authorized representative.
  - 2. "Cabling": A system comprised of cables, wire, cords, and connecting hardware [e.g., cables, termination apparatus, patch panels, blocks, connectors, outlets, labeling, etc].
  - 3. "Connect": To install required patch cords, equipment cords, crossconnect wire, etc. to complete an electronic or optical signal circuit.
  - 4. "Cord": a length of cordage having connectors at each end. The term "Cord" is synonymous with the term "Jumper" and "Lead".
  - 5. "Engineer": TEECOM Design Group.
  - 6. "Furnish": To purchase, procure, acquire, and deliver complete with related accessories.
  - 7. "Identifier": A unique code assigned to an element of the Telecommunications infrastructure that links it to its corresponding record.
  - 8. "Install": To set in place, join, unite, fasten, link, attach, set up or otherwise connect together and test before turning over to the Owner, parts, items, or equipment supplied by contractor or others. Make installation complete and ready for regular operation.
  - 9. "Pigtail": a length of cordage having connectors at one end.
  - 10. "Provide": To furnish, transport, install, erect, connect, test and turn over to the Owner, complete and ready for regular operation.

### 1.4 SYSTEM DESCRIPTION

- A. In circumstances where the Specifications and Drawings conflict, the Drawings shall govern quantity and the Specifications shall govern quality.

## 1.5 SUBMITTALS

- A. Submit required submittals to the General Contractor in the quantities and formats as required under the general contract. In the absence of requirements, provide as described in the following with reference to quantity and format.
- B. Failure to comply with requirements in part or whole shall constitute grounds for rejection.
- C. Submittal Description: Product Data
  1. Obtain written approval from the Engineer for the product data submittal prior to materials and equipment purchase order and prior to installation.
  2. Quantity: Submit product data as described in Division 01. In the absence of requirements given, submit four product data submittals.
  3. Format:
    - a. Submit each product data on 8-1/2 x 11 inch paper.
    - b. Package product data using a 3-ring binder, plastic cover, or similar.
    - c. Clearly label the cover and spine of each submittal with the following information (e.g., if in a 3-ring binder, insert the submittal information in the transparent front cover and spine pockets):
      - 1) Client Name
      - 2) Project Name and Address
      - 3) Project Submittal Number
      - 4) Submittal Name (e.g., "Product Data Submittal For Telecommunications Equipment Rooms")
      - 5) Specification Section Number (e.g., "Section 271100")
      - 6) Date of Submittal. Format: <month> <day>, <year> (e.g., "January 1, 2008")
      - 7) Contractor Name
    - d. Include a Table Of Contents at the beginning of the submittal that lists materials by article and paragraph number (e.g., "2.02 Equipment Racks").
    - e. Include tabbed separators for improved navigation through the submittal.
  4. Content:
    - a. Cover Letter: Include a cover letter stating that the submittal is in full compliance with the requirements of the Contract Documents. Sign (and stamped, if applicable) cover letter and list items and data submitted.
    - b. Product Information: Include manufacturer's technical data, product literature, "catalog cuts", data sheets, specifications, and block wiring diagrams (if necessary) to clearly describe the product's characteristics, physical and dimensional information, electrical performance data, materials used in fabrication, material color & finish, and other relevant information such as test data, typical

usage examples, independent test agency information, and storage requirements. Clearly indicate by arrows or brackets precisely what is being submitted on and those optional accessories, which are included and those which are excluded. At a minimum, include products listed in Division 27. Include relevant products that will be installed, which are not listed in the specifications.

- c. Seismic Calculations: Include anchorage calculations for floor mounted fully loaded equipment racks/frames/cabinets such that it shall remain attached to the mounting surface after experiencing forces in conformance with CCR, Title 24, Table 23P, Part II and with Section 2312 "Earthquake Regulations" of the "Uniform Building Code" for Seismic Zone 4 Area, Importance Factor of 1.25. Specify proof loads for anchors. A Structural Engineer registered in the State of California shall prepare Structural Calculations, and shall wet stamp and sign them. Refer to general contract requirements for review and approval procedures.
- d. Resubmittals: Provide a cover letter with the resubmittal that lists the action taken and revisions made to each product submittal in response to Submittal Review Comments. No review shall take place for any resubmittal packages that is not accompanied by this cover letter. Failure to include this cover letter will constitute rejection of the resubmittal package.

D. Submittal Description: Shop Drawings

1. Obtain written approval from the Engineer for the shop-drawings submittal prior to the release of materials and equipment purchase order and prior to installation.
2. Quantity and Media: Submit shop-drawings as described in Division 01. In the absence of requirements given, submit four full-size sets of shop drawings on bond or "eco-bond".
3. Format:
  - a. Produce shop drawings using AutoCAD, or other computer design application that can save files to AutoCAD-compatible files.
  - b. Use the same size drawing sheet as the drawings of the Contract Documents, and use the project title block.
  - c. Text: minimum of 3/32" high when plotted at full size.
  - d. Use identical symbols as those in the drawings.
  - e. Screen background information.
  - f. Plot system components (devices, cable routes, etc.) and text at a sufficient line weight to stand out against background information.
  - g. Label each sheet in the shop drawings set with the Specification Section Number (e.g., "271523").
  - h. Scaling:
    - 1) Scale floor plans at 1/8"=1'-0".
    - 2) Scale enlarged room plans at 1/4"=1'-0".
    - 3) Scale wall elevations at 1"=1'-0".

4) Scale rack elevations at 1"=1'-0".

4. Content:

- a. Submit shop drawings if the proposed installation differs from the Contract Documents or the design intent.
- b. Cover Letter: Accompany each shop drawing submittal with a cover letter stating that the shop drawings have been thoroughly reviewed by the Contractor and are in full compliance with the requirements of the Contract Documents. Have the person who prepared the submittal sign (and stamped, if applicable) the cover letter and include a drawing index. Failure to comply with this requirement shall constitute grounds for rejection of submittal.
- c. Drawing Information: Shop drawing submittals shall consist of floor plans, enlarged room plans, wall and rack elevations, installation details, and other aspects of the system that differ from the Contract Documents or the design intent. Use the same scales as the Drawings (e.g., 1/4" = 1'-0" for enlarged room plans).
- d. Seismic Calculations: Include anchorage calculations for floor mounted fully loaded equipment racks/frames/cabinets such that it shall remain attached to the mounting surface after experiencing forces in conformance with CCR, Title 24, Table 23P, Part II and with Section 2312 "Earthquake Regulations" of the "Uniform Building Code" for Seismic Zone 4 Area, Importance Factor of 1.25. Specify proof loads for anchors. A Structural Engineer registered in the State of California shall prepare Structural Calculations, and shall wet stamp and sign them. Refer to general contract requirements for review and approval procedures.
- e. Resubmittals: Accompany resubmittals with a cover letter that lists the revisions made to each drawing in response to Submittal Review Comments. Failure to include this cover letter will constitute rejection of the resubmittal package without review.

E. Submittal Description: As-Built Drawings

1. Quantity and Media: Submit as-built drawings as described in Division 01. In the absence of requirements given, submit one full-size set of shop drawings on bond or "eco-bond" and submit one set of electronic files on CD-ROM.
2. Format:
  - a. Produce as-built drawings using AutoCAD, or other computer design application that can save files to AutoCAD-compatible files.
  - b. Use the sheet size as the drawings of the Contract Documents, and use the project title block.
  - c. Text: minimum of 3/32" high when plotted at full size.
  - d. Use symbols identical to the symbols shown on the Drawings.
  - e. Screen background information.
  - f. Plot system components (devices, cable routes, etc.) and text at a sufficient line weight to stand out against background information.

3. Content:

- a. Submit as-built drawings that fully represent actual installed conditions and that incorporate modifications made during the course of construction.
  - b. Floor Plans: Scale floor plans at 1/8"=1'-0". Floor plans shall show:
    - 1) Locations and identifiers of telecommunications devices.
    - 2) Size, quantity, location, and routes of pathways (such as cable trays, cable basket, conduits, cable hangers, and other cable support devices).
  - c. Rooms Drawings: Applicable rooms: Data Center, Network Patching Facility, Server Room, PBX Equipment Room, Entrance facilities, MDF, BDFs, IDF. Room drawings shall show:
    - 1) Floor layouts - scaled at either 1/4"=1'-0" or 1/2"=1'-0", showing dimensioned placement of equipment cabinets/frames, rack bays, etc.
    - 2) Overhead layouts - scaled at either 1/4"=1'-0" or 1/2"=1'-0", showing dimensioned placement of overhead cable support (e.g., cable tray, cable basket, cable runway, conduit sleeves, etc.)
    - 3) Rack elevations - scaled at 1"=1'-0", showing placement of termination and other equipment installed onto rack bays
    - 4) Wall Elevations - scaled at 1"=1'-0", showing dimensioned placement of termination hardware (e.g., termination/crossconnect blocks)
- F. Submittal Description: Operation and Maintenance (O&M) Manuals
1. Quantity: Submit quantity of O&M Manuals as described in Division 01. In the absence of requirements given, submit four O&M Manuals.
  2. Format:
    - a. Submit each O & M Manual in a white, 3-ring binder with front cover and spine clear pockets for insertion of the project information.
    - b. Clearly label the cover of each O&M Manual with the following information:
      - 1) Client Name.
      - 2) Project Name and Address.
      - 3) Manual Name (e.g., "Operation And Maintenance Manual for Telecommunications Cabling System").
      - 4) Date of Submittal. Format: <month> <day>, <year> (e.g., "January 1, 2008").
      - 5) Contractor Name.
    - c. Include a Table Of Contents at the beginning that lists the contents.
    - d. Include tabbed separators for improved navigation through the manual.
  3. Content:
    - a. 11"x17" prints of as-built drawings, as described above

- b. Manufacturer's original catalog information sheets for each component provided under applicable Section (typically, this is similar to the accepted product data submittal)
- c. Warranty certificate from the manufacturer and the Contractor
- d. Manufacturer's instructions for system or component use
- e. Instructions and requirements for maintenance and warranty issues
- f. Contents shall include requirements and methods for maintaining installed products, and precautions against cleaning materials and methods detrimental to finishes and performance.

#### 1.6 QUALITY ASSURANCE

##### A. Manufacturer Qualifications

1. Five continuous years, minimum, design and manufacture of the materials and equipment specified herein.
2. Manufacturer(s) of products and equipment specified herein shall demonstrate that they have a quality assurance program in place to assure that the specifications are met. Include in the program, at a minimum, provisions for:
  - a. Incoming inspection of raw materials
  - b. In-process inspection and final inspection of the cable product
  - c. Calibration procedures of test equipment to be used in the qualifications of the product
  - d. Recall procedures in the event that out of calibration equipment is identified.
3. Conform to government standards on quality assurance for applications within these specifications.

##### B. Contractor Qualifications

1. A current, active, and valid and C7 or C10 California State Contractors License
2. Five, minimum, continuous years experience
3. Five, minimum, completed projects similar to scope and cost
4. Evidence of technicians qualified for the work

##### C. Materials

1. Materials, support hardware, equipment, parts comprising units, etc., shall be new, unused, without defects and of current manufacturer, materials
2. Use specified products and applications, unless otherwise submitted and approved in writing.

##### D. Regulatory Requirements

1. Work and materials shall conform to the latest rules of National Board of Fire Underwriters wherever such standards have been established and shall conform to the regulations of the State Fire Marshal, OSHA and the codes of the governing local municipalities. Work under Division 27 shall conform to the most stringent of the applicable codes.

2. Provide the quality identified within these Specifications and Drawings when codes, standards, regulations, etc. allow Work of lesser quality or extent. The Contract Documents address the minimum requirements for construction.

E. Drawings

1. Follow the general layout shown on the Drawings except where other Work may conflict with the Drawings.
2. Drawings for the Work within this Division are essentially diagrammatic within the constraints of the symbology applied.
3. The Drawings do not fully represent the entire installation for the Telecommunications Cabling System. Drawings indicate the general route for the cables and the location of outlets. The Drawings might not expressly show conduits, sleeves, hangers, etc., but are required.

**1.7 DELIVERY, STORAGE, AND HANDLING**

A. Delivery

1. Do not deliver products to the site until protected storage space is available.
2. Coordinate materials delivery with installation schedule to minimize storage time at jobsite.
3. Deliver materials in manufacturer's original, unopened, undamaged packaging and containers with identification labels (name of the manufacturer, product name and number, type, grade, UL classification, etc.) intact.
4. Immediately replace equipment damaged during shipping at no cost to the Owner, so as not to impact the construction schedule.

B. Storage and Protection

1. Store materials in clean, dry, ventilated space free from temperature and humidity conditions (as recommended by manufacturer) and protected from exposure to harmful weather conditions.
2. Comply with manufacturer's storage requirements for each product. Comply with recommended procedures, precautions or remedies as described in the Material Safety Data Sheets (MSDS) as applicable.
3. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris, and traffic.
4. Storage outdoors covered by rainproof material is not acceptable.
5. Provide heat where required to prevent condensation or temperature related damage.

C. Handling

1. Handle materials and equipment in accordance with manufacturer's written instructions. Handle with care to prevent damage, breakage, denting, and scoring.
2. Do not install damaged materials and equipment. Replace damaged equipment at no cost to the Owner.

### 1.8 SCHEDULING

- A. Unless otherwise specified, the construction schedules of the Sections within Division 27 may be combined into a single, overall schedule.
- B. Do not proceed without written approval from the Owner or Owner's Representative for schedule of this Work.

### 1.9 WARRANTY

- A. Provide a 20-year manufacturer's warranty for the fiber optic and twisted pair copper cabling systems from the date of acceptance.
- B. Render service within 24 hours of system failure notification. Note deviations or improvements to this service at the time of bid and obtain written acceptance from the Owner, or Owner's Representative.
- C. Manufacturers of the major system components shall maintain a replacement parts department and provide testing equipment when needed. Provide complete replacement parts within a 24-hour period during the warranty period.
- D. Conformance to certain government standards on quality assurance may be required for some applications outlined in these specifications.

### 1.10 PROJECT MANAGEMENT AND COORDINATION

#### A. Project Management and Coordination Services

1. Provide a project manager for the duration of the project to coordinate this Work with other trades. Coordination services, procedures and documentation responsibility include, but are not limited to, the items listed in this section.
2. Review of Shop Drawings Prepared by Other Subcontractors:
  - a. Obtain copies of shop drawings for equipment provided by others that require telecommunication service connections or interface with Work.
  - b. Perform a thorough review of the shop drawings to confirm compliance with the service requirements contained in the Division 27 contract documents. Document discrepancies or deviations as follows:
    - 1) Prepare memo summarizing the discrepancy
    - 2) Submit a copy of the specific shop drawing, indicating via cloud, the discrepancy
  - c. Prepare and maintain a shop drawing review log indicating the following information:
    - 1) Shop drawing number and brief description of the system/material
    - 2) Date of the review
    - 3) Name of the individual performing the review
    - 4) Indication if follow-up coordination is required

#### B. Role of the Engineer

1. During the construction phase of the project, the Engineer will work with the Contractor to provide interpretation and clarification of project contract documents, reply to (and 'process') relevant Requests for



Information (RFIs), and act as an interface between the Contractor and the Owner.

2. The Owner has retained the Engineer's services to observe the Work for general compliance with the Contract Documents and to ensure that the installation meets the design intent of the system.
3. In general, the Engineer will participate during the construction phase as follows:
  - a. Review product data and shop drawings submittals for general compliance with the contract drawings and specifications.
  - b. Review changes as they arise, and confirm that the proposed solutions maintain the intended functionality of the system.
  - c. Interpret field problems for Owner, and translate between Owner and Construction Team.
  - d. Review the testing procedures to confirm compliance with industry-accepted practices.

C. Use Of CAD Files

1. Should the Contractor need the Engineer's CAD files to produce shop drawings and/or as-built drawings, the Engineer requires the Contractor sign a CAD files release agreement.

**PART 2 - PRODUCTS**

**2.1 GENERAL**

- A. Materials used shall present no environmental or toxicological hazards as defined by current industry standards and shall comply with OSHA and EPA standards, other applicable federal, state, and local laws.
- B. Product numbers are subject to change by the manufacturer without notification. In the event a product number is invalid or conflicts with the written description, notify the Engineer in writing prior to ordering the material and performing installation work.

**2.2 PRODUCT SUBMITTAL AT TIME OF BID**

- A. At the time of bid, include a list of major products in the Contract documenting the intended cabling system solution. Examples of major products may include: horizontal cable, modular jacks, faceplates, modular patch panels, backbone cable, termination block systems, fiber connectors, fiber patch panels.

**PART 3 - EXECUTION**

**3.1 PERMITS AND INSPECTIONS**

- A. Obtain and pay for permits and inspections required for the Work.
- B. Furnish materials and execute workmanship for this Work in conformance with applicable legal and code requirements.
- C. Perform tests required herein, or as may be reasonably required to demonstrate conformance with the Specifications or with the requirements of legal authority having jurisdiction.

- D. Arrange and pay for review/inspection from compliance officials responsible for enforcement of applicable codes and regulations to establish that the work is in compliance with requirements of reference codes indicated herein.

### **3.2 EXAMINATION**

- A. Verify existing conditions, stated under other sections, are acceptable for installation in accordance with manufacturer's instructions.

### **3.3 FIELD QUALITY CONTROL**

- A. Staffing: Provide a qualified foreman who is in charge of the Work and who is present at the job site at times Work is being performed. Supervise the work force executing the Work. Perform the installation within the restraints of the construction schedule.
- B. Construction Meetings: Participate in construction coordination meetings throughout the course of construction to review the progress and to resolve issues and conflicts. Prepare and distribute meeting agenda for telecommunication issues prior to, and meeting notes after meetings, in a format acceptable to the Engineer. Provide the Telecommunication Engineer with the meeting notes within 3 business days following the meeting.
- C. Scheduling: Keep the construction schedule current, based on the results of the construction meetings. Issue revised schedules to the General Contractor for approval. At minimum, schedule must cover critical due dates, tasks, and milestones. Prepare and issue the Telecommunication Engineer updated schedules, within 3 business days, whenever there are modifications.
- D. Inspection: Perform inspection after installation. Keep areas of work accessible and notify code authorities, or designated inspectors, of work completion released for inspection. Document completion and inspection as required.

### **3.4 INSTALLATION**

- A. Complete work in a neat, high-quality manner, relative to common industry practices, and in accordance to NECA "Standard Of Installation".
- B. Conform to applicable federal, state and local codes, and telephone standards.
- C. Coordinate the entire installation with the General Contractor, and their subcontractors, to meet the construction schedule.
- D. Manufacturer's Instructions:
  - 1. Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions, and product carton instructions for installation.
  - 2. Maintain jobsite file of Material Safety Data Sheets (MSDS) for each product delivered to jobsite packaged with an MSDS.
- E. Adjusting:
  - 1. Make changes and revisions to the system to optimize operation for final use.
  - 2. Make changes to the system such that defects in workmanship are corrected and cables and the associated termination hardware pass the minimum test requirements.

F. Protection

1. Protect installed products and finish surfaces from damage during construction.

**3.5 REPAIR/RESTORATION**

- A. Replace or repair work completed by others that you deface or destroy. Pay the full cost of this repair/replacement.

B. Punch List:

1. Inspect installed work in conjunction with the General Contractor and develop a punch list for items needing correction.
2. Provide punch list to Engineer for review prior to performing punch walk with the Engineer.

C. Re-Installation:

1. Make changes to adjust the system to optimum operation for final use. Make changes to the system such that defects in workmanship are correct and cables and the associated termination hardware passes the minimum test requirements.
2. Repair defects prior to system acceptance.

**3.6 CLEANING**

- A. Remove temporary coverings and protection of adjacent work areas. Remove unused, excess, and left over products, debris, spills, or other excess materials. Remove installation equipment.
- B. Leave finished work and adjacent surfaces in neat, clean condition with no evidence of damage.
- C. Repair or replace damaged installed products.
- D. Legally dispose of debris.
- E. Clean installed products in accordance with manufacturer's instructions prior to Owner's, or Owner's Representative's, punch walk.

**3.7 FINAL INSPECTION AND CERTIFICATION**

A. Punch Walks and Punch Lists

1. Punching the Work of individual Sections of Division 27 may be combined.
2. Execute a punch walk with the Engineer and the Owner or Owner's Representative to observe Work.
3. Develop a punch list for items needing correction. Issue this punch list to Engineer.
4. Correct the Work as noted on punch list.
5. Execute follow up punch walk with the Engineer and the Owner or Owner's Representative to verify punch list items have been corrected.

B. System Acceptance

1. Complete corrections (punch list items) prior to submitting acceptance certificate.
2. On completion of the acceptance test, submit system acceptance certificate to the Owner or Owner's Representative requesting their

signature and return of the certificate. Issue copies of the signed certificate back to the Owner or Owner's Representative with copy to the Engineer.

C. Training

1. After acceptance, schedule a time convenient with the Owner, or Owner's Representative, for instruction in the configuration, operation, and maintenance of the system.
2. Provide 4 hours, minimum, of on-site training by a factory-trained representative. Document dates and times of training, and submit a "sign in" sheet for individuals trained, as part of the close out documentation.

- - - E N D - - -

**SECTION 27 52 23**

**TELECOMMUNICATION NURSE CALL SYSTEMS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes: Nurse Call Systems
- B. Related Sections
  - 1. Comply with the Related Sections requirements of Section 270511.

**1.2 REFERENCES**

- A. Comply with the References requirements of Section 270511.
- B. In particular or addition to the codes and standards listed in Section 270511, comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
  - 1. Facilities Guidelines Institute (FGI):
    - a. "Guidelines for Design and Construction of Health Care Facilities"
  - 2. U.S. Department of Health and Human Services (HHS)
    - a. Health Insurance Portability and Accountability Act (HIPAA)
  - 3. National Fire Protection Agency (NFPA):
    - a. NFPA 70, "National Electrical Code", Article 517
    - b. NFPA 99, "Standard for Health Care Facilities"
  - 4. Underwriters Laboratories, Inc. (UL)
    - a. UL 13, "Power-Limited Circuit Cables"
    - b. UL 1069, "Hospital Signaling and Nurse Call Equipment"
  - 5. National Electrical Manufacturers Association (NEMA) "Installation Guide for Nurse Call Systems", R2007
  - 6. U.S. Department of Veterans Affairs
  - 7. The Joint Commission
  - 8. Healthcare Information Technology Standards Panel (HITSP)
  - 9. Health Level Seven (HL7)

**1.3 DEFINITIONS**

- A. Definitions as described in Section 270511 shall apply to this section.
- B. In addition to those Definitions of Section 270511, the following list of terms as used in this specification defined as follows:
  - 1. "ADT": Admission, Discharge & Transfer

2. "LAN": Local Area Network
3. "PoE": Power-over-Ethernet (as defined the IEEE 802.3af standard)
4. "VLAN": Virtual LAN (traffic-controlled subnet)

#### 1.4 SYSTEM DESCRIPTION

- A. System shall be UL1069 listed.
- B. System components, hardware, accessories, software, and firmware shall be from a single manufacturer.
- C. The System manufacturer shall have sole control over all of the System's software source code.
- D. The System, in its entirety, shall facilitate for the Owner's compliance to HIPAA, and no software or other component shall inhibit or hinder such compliance.
- E. Base Bid Work
  1. The Work of this Section includes materials, accessories, fasteners, etc., and the labor and associated services necessary for a complete working nurse call system, herein "System". The Work also includes coordination through the General Contractor with other trades and with the Owner / Owner's Representative (e.g., IT Department).
  2. Stations, equipment, software etc. (as described in this Article)
  3. One pillow speaker per bed
  4. Wires, cables, terminations, programming, commissioning and user training.
- F. Work Provided Under Other Sections
  1. IP-based Network / LAN, WAN: Core switch(es), routers, firewalls, distribution switches, access switches, PoE switches
  2. WLAN Access: Access points, radios, authentication/controller, network appliances
  3. Power (electrical wiring, raceway, receptacles, and circuiting)
  4. Primary building pathways [refer to Section 270533 for additional information]
  5. Equipment room and room fit-up, such as equipment racks, backboard, etc\_
- G. Integration and/or Interface Requirements with Other Systems
  1. The System shall interface with the Owner's ADT system.
  2. The System shall interface with Owner's LAN, The Owner (or Owner's representative) will configure the LAN to build a VLAN that will separate System's data traffic from other hospital LAN traffic.
  3. The System shall integrate with the Owner's telephone system via an open architectural interface.
  4. The System shall integrate with the Owner's paging system via an open architectural interface.

5. The System shall integrate with the Owner's wireless staff communications (such as Vocera and/or Ascom phones) in that the master station and associated call display stations lists active pages called from these wireless staff communications devices.
6. The System shall integrate with the Owner's Patient Wandering system and shall support the following:
  - a. Patient tracking, showing locations on screen
7. The System shall interface with the Owner's bed systems.
8. The System shall interface with the Owner's lighting control system.
9. The System shall interface with the Owner's patient entertainment system (hospital grade television and multi-channel music source).
10. The system shall have the capability to interface with an IPTV system (for future deployment capability).
11. The System shall interface with the Owner's CCTV system for patient viewing/interface. Provide a single contact closure for each patient room / and or patient station to indicate two-way audio call in progress.

#### H. Coordination Requirements with Other Trades

1. Coordinate patient control units with items controlled that are not part of nurse call equipment.
  - a. TV: Channel selection and volume.
  - b. Lights: Reading light at patient location.
  - c. TV: Audio suspension when patient calls are placed on system.
2. Coordinate wiring routes and maintenance access at locations listed below. Coordinate trim features and finishes at these locations to present a unified design appearance, such as:
  - a. Patient head-wall units
  - b. Patient consoles/stations
  - c. Patient beds with built-in nurse call features
  - d. Master station
  - e. Duty station

#### I. System Features, Capabilities, and Stations

1. System shall be server-based and shall communicate with servers via an IP-based network.
2. System configuration programming changes shall not require any exchange of parts and/or components, and should be capable of being executed remotely via a VPN connection. Programming, software, and/or firmware changes/upgrades shall be accomplished on a working system without interruption to the basic (code-compliant) operation of the system. A single command shall switch all upgraded components to the new programming change / firmware upgrade. In the event of an error or failure in the update process, the system shall revert back to the previous firmware.

3. Stations and other System elements shall feature non-volatile memory/storage of operating firmware and software.
4. System communications (master stations, staff stations, patient stations, pillow speakers, intercom stations, etc.) shall be full duplex audio.
5. The entire System shall be monitored for operational status, including the following stations: master stations, staff stations, duty stations, corridor/dome lights/stations, patient stations, controllers, work flow stations. Station problems shall report to any designated console, PC, e-mail, or wireless device. Remote diagnostics shall quickly locate and identify the problem. The System, through its supervision feature, shall detect the problems within the Systems and shall notify the associated Hospital personnel (e.g., Engineering), such as the following:
  - a. Power lost
  - b. Faulty device
  - c. Troubled connections
  - d. Breaker open
6. Master Station: The System shall provide a primary control and communications unit at the master stations.
  - a. This station shall feature a touch-screen LCD (or similar) display as the primary user interface.
  - b. The display shall list calls within the unit in order of the prioritization policies (as defined by the Hospital). The list shall include room number and patient information per call.
  - c. The station shall have an integrated telephone.
  - d. Graphical presentation (e.g., floor plan) of call originations
7. Staff Sign-On Capabilities: Bar code and/or HID
8. Work-Flow Panel: The System shall include a work-flow panel behind the nurse stations.
9. The System shall support a GUI interface that resides on the hospital LAN. This interface consists of multiple modules such as staff assignment, PC call display, call detail recording, exception reporting, etc.
10. The System shall support 990 call processes to facilitate work flow and call escalations to various staff and or groups.
11. PC Console: The System shall come with a computer for control and programming, loaded with "PC Console" software. This computer shall interface with System's overall software, server-based applications, and reporting software.
12. Reporting Software: The System shall come with a server-based administrative reporting software package including standard global reports, individual user reports, call response times, quality of service reports, state required performance criteria, etc. This software shall be customizable to suit the reporting needs of each nursing unit, administration, engineering, etc., and for audit



- purposes. The reporting software shall be accessible via ODBC-compliant reporting software. The reporting software shall have produce standard and customizable reports, 'exportable' to Adobe Acrobat, such as the following:
- a. Daily/Weekly/Monthly Call Statistics by Unit/Room
  - b. Room/Unit activity
  - c. Staff Registration
  - d. Staff Productivity
  - e. Staff Sign On
  - f. Staff Assignments
  - g. Patient Activity
  - h. Devices
- J. Call Types: The System shall feature, at a minimum, the following call types:
1. "Staff Emergency" or "Staff Assist" Call:
    - a. "Staff Emergency" calls shall be generated by the momentary activation of a "Staff Emergency" (or "Staff Assist") button on a staff station, patient station, duty station, or other station equipped with such a button.
    - b. Upon call initiation, the System shall:
      - 1) At calling station, flash the "call" indicator at ½-second intervals
      - 2) Notify those caregivers associated to the originating station.
      - 3) At associated master station, display the call's initiating station/room number and (as applicable) bed number/letter with description/word "staff assist" or "staff emergency" adjacent to room/bed number, with wording fast flashing
      - 4) At associated staff and duty stations, the "Staff Emergency" (or similar) indicator shall flash
      - 5) At the dome light outside patient's room and (as applicable) the zone light, flash lamps in sequence red-white-green-yellow
      - 6) At the associated master station, staff stations, and duty stations, the tone shall increase to 1/2-second intervals
    - c. Staff Emergency calls shall be canceled by any of the following:
      - 1) Qualified personnel can cancel the call only at calling station; emergency stations that can be canceled accidentally by patients will not be accepted.
  2. "Lavatory/Toilet Emergency" or "Shower Emergency" Call:
    - a. Lavatory/Toilet Emergency and/or Shower Emergency calls shall be generated by pulling on a break-away cord to a snap-action detector.
    - b. Upon "Lavatory/Toilet" and/or "Shower" emergency call initiation, the System shall:

- 1) At the calling station, illuminate the call indicator
  - 2) Notify those caregivers associated to the originating station.
  - 3) At the dome light outside patient's room and (as applicable) the zone light, slow flash the yellow light
  - 4) At associated master station, display the call's initiating station/room number and (as applicable) bed number/letter with description/word "Toilet" or "Bath" (respective to the station's location) adjacent to room/bed indication
  - 5) At associated master station, staff stations, duty stations, and zone lights, sound tone at 1-second intervals
  - 6) At associated staff and duty stations, the call indicator (or URGENT indicator) shall flash slowly.
- c. Upon "Lavatory/Toilet" and/or "Shower" emergency call initiation, the System shall:
- 1) At associated master station, display the call's initiating station/room number and (as applicable) bed number/letter with description/word "Bath" adjacent to room/bed indication
  - 2) At associated master station, staff stations, duty stations, and zone lights, sound tone at 1-second intervals
  - 3) At associated staff and duty stations, the call indicator (or URGENT indicator) shall flash slowly.
  - 4) Emergency calls shall be canceled by any of the following:
    - a) Qualified personnel can cancel the call only at calling station; emergency stations that can be canceled accidentally by patients will not be accepted.
3. "Routine" Call:
- a. Routine calls shall be generated by momentary activation of patient's call cord, a button on the pillow speaker, or by a button directly on the patient station.
  - b. Upon call initiation, the System shall:
    - 1) At patient station, illuminate the call indicator
    - 2) At the dome light outside patient's room and (as applicable) the zone light, illuminate the white lamp
    - 3) At associated master station, display the call's initiating station/room number and (as applicable) bed number/letter with description/word "routine" adjacent to room/bed indication and produce a short-duration tone that slowly repeats
    - 4) At associated duty stations, illuminate "Routine" call indicator and produce a short-duration tone that slowly repeats
  - c. Routine calls shall be canceled by any of the following:
    - 1) Answering the call from the nurse master control station
    - 2) Momentarily pressing the "reset" button on the calling station

4. "Locking" Call:
  - a. Locking calls shall be generated by momentary activation of patient's call cord, a button on the pillow speaker, or by a button directly on the patient station.
  - b. Upon call initiation, the System shall:
    - 1) At patient station, illuminate the call indicator
    - 2) At the dome light outside patient's room and (as applicable) the zone light, illuminate the white lamp
    - 3) At associated master station, display the call's initiating station/room number and (as applicable) bed number/letter with description/word "Go To Room" adjacent to room/bed indication and produce a short-duration tone that slowly repeats
    - 4) At associated duty stations, illuminate "Routine" call indicator and produce a short-duration tone that slowly repeats
  - c. Locking calls shall be canceled by any of the following:
    - 1) Momentarily pressing the "reset" button on the calling station
5. "Cord Out" and "Out Of Bed" Call:
  - a. Cord Out calls shall be generated upon removal of call-cord or a pillow speaker from its station receptacle.
  - b. Upon call initiation, the System shall:
    - 1) At patient station, illuminate the call indicator
    - 2) At the dome light outside patient's room and (as applicable) the associated zone light, flash the white lamp
    - 3) At associated master station, display the call's initiating station/room number and (as applicable) bed number/letter with description/word "Cord Out" adjacent to room/bed indication and produce a short-duration tone that slowly repeats
    - 4) At associated duty stations, illuminate call indicator and produce a short-duration tone that slowly repeats
  - c. Cord Out calls shall be canceled by any of the following:
    - 1) Cord-set or pillow speaker is replaced
    - 2) Dummy plug or some other type call device is inserted into patient station receptacle
- K. Call Management: The System shall manage each call based on System programming.
  1. The System shall prioritize calls based on programmed call priority types, such as emergency calls before routine calls.
  2. Master stations and remote call displays shall display calls in order based on programmed criteria, such as emergency and/or in the order the calls were initiated.
  3. Master stations shall annunciate via an audible signal when a call remains unanswered within a programmed time period.

4. The System shall automatically upgrade in priority "Lavatory/Toilet Emergency", "Shower Emergency", or "Staff Assist" (emergency) calls if not answered in a preset amount of time. When an 'overtime' condition exists, the following shall occur:
  - a. Calling station shall remain in an illuminated mode
  - b. At the associated dome light outside patient's room and zone light, slowly flash the red lamp
  - c. At the master station, display and flash the following wording for the respective calls:
    - 1) "Lavatory/Toilet" and "Overtime"
    - 2) "Shower" and "Overtime"
    - 3) "Staff Assist" and "Overtime"
  - d. At associated master station, display the call's initiating station/room number and (as applicable) bed number/letter with description/word "staff assist" or "staff emergency" adjacent to room/bed number, with wording slow flashing
  - e. At the associated master station, staff stations, and duty stations, the tone shall increase to 1-second intervals
  - f. At associated staff and duty stations, the call indicator (or URGENT indicator) shall flash slowly.
  - g. Priority calls shall be canceled by any of the following:
    - 1) Pull-cord emergency stations: returning activated station's actuator to up ("off") position
    - 2) Pushbutton-type emergency stations: pressing two "reset" points simultaneously on front panel of activated station; space 'reset' points to prevent accidental reset of station and unmarked as to function
5. The System shall automatically upgrade in priority "Routine", "Locking", or "Cord Out" calls if not answered in a preset amount of time. When an 'overtime' condition exists, the following shall occur:
  - a. Patient room's dome light and the zone light flash slowly
  - b. At the associated master station, staff stations, and duty stations, the tone shall increase to 1-second intervals
  - c. At associated staff and duty stations, the call indicator (or URGENT indicator) shall flash slowly.
  - d. At the master station, display the following wording for the respective call types:
    - 1) "Overtime" for "Routine" calls
    - 2) "Room stat" for overtime "Locking" calls
    - 3) "Cord stat" for overtime "Cord Out" calls.
  - e. Priority calls shall be canceled by any of the following:
    - 1) Momentarily pressing the 'reset' button on the calling station

L. Call Log: The System shall log call information into the System's database, including the following information:

1. Date and time stamp
2. Unit
3. Staff
4. Station ID / location / room
5. Call type
6. Patient information
7. Duration to answer/cancel

M. Services

1. The installer shall provide final design services. These final design services include the following:
  - a. Verify the design shown in the Contract Documents.
  - b. Conduct a meeting with the manager of each nursing unit. Meetings shall (at a minimum) gather details specific to each unit; document coverage and call priorities; staffing patterns; and other pertinent details that will affect the final design. Produce a staff member list and, if needed, Pocket Page Tag Message list for input into the System's programming.
  - c. In-service Scheduling materials and sample of training materials will be provided.
  - d. Conduct a follow up meeting with the manager of each nursing unit. Meetings shall (at a minimum) review the shop drawings - floor plans, system diagrams, etc., confirm the function and operation of the System and equipment, and confirm System programming.
2. The installer shall provide integration services. These integration services include the following:
  - a. Pre-installation coordination of the design and implementation tasks with the Owner (or Owner's Representative / IT Dept), information required from the Owner, and all information to the Owner regarding network settings (e.g., VLAN build, etc.).
  - b. Pre-installation coordination of the implementation tasks with the General Contractor and their subcontractors (e.g., electrical contractor for power service and telecom contractor for pathways).
  - c. Pre-installation schedule planning of the entire implementation
3. The installer shall provide extended support services, including extended warranty, for a period of 5 years (labor and material).

#### 1.5 SUBMITTALS

- A. Comply with the Submittal requirements of Section 270511.
- B. Quantity: Furnish quantities of each submittal as noted in Section 270511.

C. Submittal Requirements Prior to the Start Of Construction:

1. "Authorized Distributor" certificate on manufacturer's letterhead
2. Product Data, including complete bill of materials listing all components.
3. System Operation Narrative Submittal: System operation narrative shall include, at a minimum:
  - a. Master station 'menuing', including menu sequences and soft key functions
  - b. Call routines, including definitions, sequence of operation, and cancellation requirements
  - c. Call prioritization requirements, including sequence of operation during prioritization
  - d. Reporting software, including both and overall list (with unique report names per report) of factory-programmed and custom-programmed reports and detailed descriptions of each list
4. Shop Drawings Submittal: Shop drawings to include:
  - a. Plans (floor and reflected ceiling as applicable), showing device locations and pathways
  - b. Point-to-point wiring diagram in block or riser format, showing System components, conduit and wire connections with legend (listing types and sizes), and signal, control, and power connections with legend (listing requirements)
  - c. Elevations, including equipment cabinets, wall-mounted equipment, central controller, master stations, staff stations, head wall configurations, and (as applicable) foot wall configurations, patient stations, duty stations, emergency stations, CODE stations, and other related stations; elevations shall note installation heights
  - d. Station installation details, including conduit and backbox requirements
  - e. Structural calculations for equipment anchorage [refer to Section 270511: Basic Communications Requirements]
5. Integration Submittal:
  - a. Diagram of proposed system, including system components/station, interconnectivity/wiring, and pathway requirements (dedicated, pathways, pathways shared with other systems and fill calculations)
  - b. Integration with the Owner's network and servers, and System's connectivity requirements (physical requirements, network setting requirements, protocols, etc.) - a diagram of network relationships
  - c. Proposed sequence of Work
  - d. Integration process flow chart
  - e. Narrative of Owner requirements (what the Integrator requires from the Owner)

6. Schedule Submittal: Submit proposed schedule of work.
7. Testing Procedures Submittal:
  - a. Submit a step-by-step manual for which the System will be tested.
- D. Submittal Requirements at Close Out:
  1. As-Built Drawings
  2. Final testing documentation, listing test results of each station, device, etc.
  3. O&M Manual
  4. Warranty Certificate, including System manufacturer's obligations, services, terms, and conditions. Warranty certificate shall describe renewal options.
- E. Substitutions
  1. Requests for substitutions shall conform to the general requirements and procedure outlined in Section 270511.

#### 1.6 QUALITY ASSURANCE

- A. Comply with Quality Assurance requirements of Section 270511.
- B. Manufacturer Qualifications
  1. Manufacturer shall have at least 20 years of regular (non-interrupted) experience in manufacturing nurse call equipment similar to that required for this Project.
  2. Manufacturer shall provide to Owner, at no cost to the Owner, factory training and training manuals.
  3. Manufacturer shall provide to Owner, at no cost to the Owner, telephone technical support services on a 24-hour per day basis.
  4. Manufacturer shall maintain, at no cost to the Owner, access to parts and to emergency maintenance and repair on a 24-hour per day basis with a 24-hour maximum response time.
- C. Installer Qualifications
  1. Installer shall have successfully completed factory training and shall be authorized by the manufacturer as a distributor and installer for the proposed System. The Installer shall submit a copy of the manufacturer's authorization Certificate with proposal (during bid).
- D. The Installer shall be certified by the manufacturer for network equipment, software, components, etc. The Installer shall make a Certificate copy available upon request.
- E. Installation Observations
  1. Manufacturer shall provide factory-authorized service representative to observe, even supervise, the installation (observe and monitor the installing contractor's practices for correctness: cable placement, mounting of devices, device connections, compliance with the installation schedule), programming, start-up, and testing of the System.

### **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Comply with Delivery, Storage and Handling requirements of Section 270511.

### **1.8 WARRANTY**

- A. Warrant System to perform as described within this Section for a period of 5 years from the date of Owner's written acceptance. Correct deficiencies within 24 hours of notification. Exceptions:
  - 1. Warrant call cords and pillow speakers for a period of 2 years.
- B. Manufacturer shall warrant all manufactured hardware for a period of 5 years.
- C. Manufacturer shall provide, free of charge, firmware/software upgrades (for patches, product feature enhancements, etc.) for a period of <1 year> from date of Owner's written acceptance.
- D. Warranty calls shall have a technician on site within 4 hours of initial service call.

## **PART 2 - Products**

### **2.1 GENERAL REQUIREMENTS**

- A. Components, parts, accessories, wires/cables, and similar System products shall be listed for their intended purpose and for flammability requirements.
- B. Manufacturing Criteria
  - 1. Equipment shall be manufactured using surface mount technology (SMT) and manufacturing testing shall utilize ATE (Automated Test Equipment) to assure the highest quality production. Specifying authority may request test procedures and/or results of tests on specific equipment being supplied. Manufacturer's testing procedures must be available upon request, including test equipments model number, serial numbers and date of last calibration.
- C. Flush-Mounted Devices
  - 1. Stations, such as patient and staff stations, shall be flush mounted using snap-tight cover plates. Fasteners/screws shall be hidden. Sub-plates shall be slotted and adjustable for trimming the mounting for "squaring" the vertical and horizontal fit.
- D. Sealed User interface
  - 1. Stations, such as patient and staff stations, shall feature a bio-seal cover over buttons and other user interfaces - resistant to disinfectant cleaners.

### **2.2 MASTER STATION**

- A. Master station shall be interactive with an associated PC workstation (user provided) without the necessity of any interconnection to the PC. The work process relationship shall be software defined through the network connections.



- B. For Systems with multiple master stations connected to the same central logic, master stations shall operate independently.
- C. Master station shall be able to answer calls not answered by another master station in another unit, or to receive calls from a master station that has failed or has been unplugged, or otherwise not receiving the call.
- D. Master station shall have the ability to 'program' individual patient station call priorities, swing an individual room or any group of rooms by touching one labeled touch point, and group monitor. Room(s) and consoles may be assigned anywhere within hospital nurse/patient communications network.
- E. Master station shall come with an integrated handset and key pad (for dialing), though the console shall also have a 'soft key pad' (on the console screen) for touch-screen dialing.
- F. Master station shall have group monitor capabilities either pre-assigned groups of stations (also tying into pre-assigned shofts) or 'programmable' (stations selected by operator)
- G. Master station shall interface with floor/unit paging to permit local paging from master station.
- H. Master station shall have password protection, with enable/disable capability.
- I. Master station shall be desk or wall-mountable.
- J. Communications and Call Modes
  - 1. Handset and hands-free (via built-in speaker and microphone)
  - 2. Full duplex between master station and: patient stations, staff stations, duty stations, wireless communications devices (Vocera /Ascom / Spectralink)
  - 3. Unique tone and message for each incoming call to clearly indicate origin and priority of call (adjustable level) with a frequency and repetition rate based upon the highest priority call registered.
  - 4. While monitoring a group of stations, quickly select any station and temporarily mute the others without having to dial that room selectively
  - 5. Optional tone/mute of calls in progress
  - 6. Ability to block all nurse call loudspeaker paging (for a low-noise patient environment)
  - 7. Place calls on 'Hold'
  - 8. Automatic tone muting of routine calls when master station is 'in use'
  - 9. Single-touch tone muting of 'priority', 'emergency', and 'CODE' calls at master station with automatic self-restoration to normal tone mode after cancellation of call
- K. Display
  - 1. Color display

2. Time of day, either 12 or 24 hour (set by user)
- L. Display Content and Control
1. Simultaneously display 5 (minimum) calls from any combination of stations with automatic prioritizing of calls by type and time of call placement - each with an individual elapsed timer; elapsed timer shall track and log the duration from when the call was placed to when the call was answered
  2. Call list shall display room number and (as applicable) bed number
  3. Call list shall display call type and priority
  4. Scroll to see incoming calls
  5. Direct selection of calls displayed for answering or automatic answering of calls by priority and age
  6. Automatic redisplay and priority up-grade of "overtime" and "service needed" calls
- M. Time Synchronization: Time shall synchronize to hospital standard network time
- N. Power over Ethernet powered connection Ethernet-based System controller. No local power supplies required.
- O. Ability to create up to 32 soft keys, user-configurable, with 4 buttons, 8 screens deep.

### 2.3 DUTY STATION

- A. Duty station shall be 'programmable' through the System control software to accept and/or produce various call routines, notifications, status conditions, priorities, etc. as described in "System Description".
- B. Audio Communications:
1. Duty station shall have an integrated (built-in) speaker and microphone to facilitate for two-way hands-free communication.
  2. During calls with the master station (and/or other stations), the Duty station shall illuminate a "monitor" (or similar) indicator.
- C. Call Management
1. Duty station shall simultaneously support up to 3 calls, displaying these calls individually,
  2. Duty station shall allow the user control over individual calls (via a touch screen, arrow buttons, or similar).
- D. Visual Communications: Duty station shall produce visual signaling to a corridor and/or zone light..
- E. Duty station shall have one "Staff Assist" (or similar) button.
- F. Duty station shall have a "reset" (or similar) button for call cancellation.

## 2.4 CORRIDOR AND ZONE LIGHTS

- A. Corridor and zone lights shall contain four sections, each lit by a long life, RGB LED (lamp) capable of producing 7 colors.
- B. Each section shall have a diffusion lens that allows for 180-degree horizontal visibility of call lamps. The corridor and zone lights shall be capable of the following:
  - 1. All segments of corridor light can indicate a call in any of the following 7 colors: Blue, Red, White, Green, Orange, Yellow, and Pink
  - 2. Custom call patterns (any combination of light segments, such as all segments blue for code blue).
  - 3. Flash any single color or strobe the sections of the light in any color pattern.
- C. The following indications shall be provided by corridor and zone lights [also refer to "Call Types" previously]:
  - 1. Steady white: "routine" and "locking" calls from patient, staff, and duty stations
  - 2. Flashing white: "out of bed" and "out of bed" overtime, "cord out" and "cord stat", patient, staff and duty station overtime, "locked" overtime and priority calls
  - 3. Flashing yellow: "bath", "shower", or "lavatory/toilet" calls and "bath", "shower", or "lavatory/toilet" overtime calls
  - 4. Flash lamps in sequence red-white-green-yellow: "Staff Assist" or "Staff Emergency"
  - 5. Flashing green: "nurse needed" and "nurse needed overtime"
  - 6. Flashing Red: "fire alarm notification" calls

## 2.5 PATIENT STATION

- A. Patient station shall be 'programmable' through the System control software to accept and/or produce various call routines, notifications, status conditions, priorities, etc. as described in "System Description".
- B. Patient station shall accept any call cord and/or pillow speaker described elsewhere in this Section.
- C. Audio Communications:
  - 1. Patient station shall have an integrated (built-in) speaker and microphone to facilitate for two-way hands-free communication via the built-in speaker/microphone or the pillow speaker (plugged into the patient station).
  - 2. During calls with the master station (and/or other stations), the patient station shall illuminate a "monitor" (or similar) indicator.
  - 3. Patient station shall have the ability to be placed into a "privacy" mode, where the master station cannot monitor the patient's room without first sounding a distinct pre-announce tone at the patient

- station. Provide "privacy mode" to be programmable from the nurse master control station. By placing a station in "privacy," all other stations in the same room become "private" to prevent monitoring a "private" station via another station.
- D. Patient station shall have the following controls / buttons / indicators:
1. 1 "Call" button
  2. 1 "Staff Assist or Staff Emergency" button
  3. 1 monitor indicator (e.g., LED)
  4. 1 "Cancel" (or similar) button to cancel calls at the station
- E. Patient station shall have the following connections:
1. 1 connection (for pillow speaker)
  2. 1 1/4-inch auxiliary jack (for connecting and monitoring of pump/ventilator type alarms)
- F. Patient station shall have a "Reset" (or similar) button or feature to allow changing of cord-sets and/or pillow speakers without generating a "cord out" call.

## 2.6 PULL-CORD EMERGENCY CALL STATION

- A. Pull-cord type emergency call station shall operate in conjunction with/connected to a patient station, room control module, staff station, or duty station of this Section.
- B. Refer to "System Description" for System's management of call signals initiated from pull-cord emergency call stations.
- C. Pull-cord type emergency call stations shall be of all solid-state construction and containing no mechanical switches, incandescent lamps or relays.
- D. Pull-cord type emergency call station types:
1. Pull-cord emergency call station, intended for deployment in lavatory (toilet) rooms
  2. Pull-cord emergency call station, intended for deployment in shower rooms
- E. Pull-cord type emergency call station shall have the following controls / buttons / indicators:
1. 1 pull cord to initiate call
  2. 1 "Call" (or similar) button to initiate and cancel call
  3. 1 monitor indicator (e.g., LED)
- F. Pull-cord product shall be an anti-ligature material in length to match location and height of device.

## **2.7 "STAFF ASSIST" CALL STATION**

- A. "Staff Assist" call station shall operate in conjunction with/connected to a patient station, room control module, staff station, or duty station of this Section.
- B. Refer to "System Description" for System's management of call signals initiated from "Staff Assist" call stations.
- C. "Staff Assist" call station shall have the following controls / buttons / indicators:
  - 1. 1 "Staff Assist" (or similar) button, to initiate call
  - 2. 1 "Cancel" (or similar) button to cancel calls at the station
  - 3. 1 call-initiated indicator (e.g., LED)

## **2.8 AUXILLARY PORT STATION**

- A. The auxiliary port station shall operate in conjunction with/connected to a patient station, room control module, staff station, or duty station of this Section.
- B. The auxiliary port station shall provide interface for a call cord switch, patient monitoring equipment, and other bed-related apparatus.
- C. The auxiliary port station shall present the following connections:
  - 1. 1 1/4-inch jack (for auxiliary equipment or call cord)
- D. The auxiliary port station shall have the following controls / buttons / indicators:
  - 1. 1 "Cancel" (or similar) button to cancel calls at the station

## **2.9 BED STATION**

- A. The bed station shall provide interface for feature beds, bed-side equipment, and other bed-related apparatus.
- B. The bed station shall connect to the following connection:
  - 1. 1 37-pin connection (for a feature bed by others)

## **2.10 PILLOW SPEAKER**

- A. Pillow speakers shall fully function with any standard hospital-grade TV or shall interface with a third-party patient entertainment system or other menu-driven system. TV control shall be a programmed function of the System.
- B. Pillow speakers shall be enclosed in a UL 94V-0 rated molded plastic case and shall be biomedically sealed.
- C. Pillow speakers and associated cords shall be electro-static discharge (ESD) shielded for protection of patients and staff.
- D. Pillow speaker shall have the following functions and controls:
  - 1. Speaker/microphone for full duplex communications to master station; speaker also for TV audio

2. 1 "Nurse" (or similar) call button
  3. 2, min, additional call buttons (customizable function)
  4. TV power (on/off)
  5. TV volume control (up/down and mute)
  6. TV channel control (up/down)
  7. TV channel select keypad (e.g., numbers)
  8. TV closed caption control (on/off)
  9. Music channel control (up/down)
  10. Lighting control (dimming and/or preprogrammed settings - via third party control system)
- E. Pillow speakers shall have call assurance and monitor LEDs.
- F. When the pillow speaker is plugged into a patient station, the System shall transfer audio communications to the pillow speaker.

#### **2.11 WIRES AND CABLES**

- A. Proprietary wires and cables shall be listed for nurse call systems and shall be plenum rated and listed as such.

#### **2.12 LABELS**

- A. Labels for Wires and Cables
1. Labels shall be machine-printable via a laser printer, ink jet printer, thermal transfer printer, or hand-held printer
  2. Labels shall be adhesive-backed and have a self-laminating feature.
  3. Printable Area: 2" x 0.5", minimum.
  4. Color: White.

### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- A. Comply with the Execution requirements of Section 270511.

#### **3.2 EXAMINATION AND PREPARATION**

- A. General: Prior to the start of this Section's Work, examine telecommunications rooms, nurse desks, patient areas, and other spaces to receive System components to ensure conditions are acceptable for System installation in conformance with manufacturer's instructions and Specification tolerances. Notify in writing the Owner's Representative of conditions that would adversely affect the installation, or subsequent utilization, of the system. Do not proceed with the installation until unsatisfactory conditions are improved to satisfactory conditions.
- B. Pathways Provided By Others: Prior to the start of this Section's Work, verify that pathways and supporting devices, provided under other

Sections, are properly installed, and that temporary supports, devices, etc., have been removed. Verify pathway dimensions, including length (for example, "True Tape" the conduits).

- C. Pathways: Plan routes and locations of supplemental pathways in advance of the installation. Coordinate routes and locations through General Contractor with other trades (telecommunications pathways, electrical raceways, ductwork, plumbing, ceilings, wall construction, etc.). Pathways shall not unnecessarily cross other conduits or pipe, shall not prevent removal of ceiling tiles or panels, and shall not block access to mechanical or electrical equipment. Provide offsets as required to avoid obstruction of pathways with other trades.
1. Where possible, plan pathway routes parallel or at right angles to the centerlines of columns and beams.
  2. Pathways shall be no closer than 12 inches to a flue, parallel hot water, steam line or other heat producing source, or 3 inches from such lines when crossing perpendicular to the runs.

### 3.3 INSTALLATION

#### A. System Programming

1. Program into the System the call types and prioritizations according to the approved Submittals (pre-installation requirements gathered during the 'final design' meetings with the nursing units).

#### B. Master Stations

1. Set in place and connect master stations.
2. Download each respective profile onto master stations.

#### C. Reporting System

1. Install reporting software onto OFOI server.
2. Install and ensure operation of at least 10 'factory-programmed' reports.
3. Program at least 10 additional reports per Owner requirements.

#### D. Wiring and Cabling

1. Wire and cable runs shall have continuous sheath continuity, homogenous in nature. Splices are not permitted anywhere.
2. Size wiring to conform to the equipment Manufacturer's requirements.
3. Wire color-coding shall remain the same throughout the system.
4. Placement
  - a. Place wires and cables within designated pathways.
  - b. Place and suspend wires and cables in a manner to protect them from physical interference or damage. Place wires and cables with no kinks, twists, or impact damage to the sheath. Replace wires and cables if damaged during installation.
  - c. Place wires and cables within manufacturer's minimum bend radius or 6 times the cable diameter during and after installation, whichever is larger.

- d. Place wires and cables within manufacturer's pulling tension limits.
  - e. Place a pull string along with cables where run in conduit and spare capacity still exists in the conduit. Tie off ends of the pull rope.
5. Routing
- a. Route wires and cables a minimum of 6" away from power sources (to reduce interference from EMI).
  - b. Within equipment rooms and/or at equipment enclosures, utilize the overhead and vertical cable support. On overhead cable support, do not provide cable ties; cables shall lie loosely. On vertical cable support, do provide cable ties every 24 inches on center.
6. Termination
- a. Provide 1 to 2 feet of cable slack at each end of the run. Store slack in overhead cable support or as noted on Drawings.
  - b. Properly relieve strain from cables at termination points per manufacturer's instructions.
  - c. For CATEGORY cables, terminate twisted pairs onto the termination apparatus in accordance with manufacturer's latest instructions and TIA/EIA-568-B standard installation practices.
  - d. For power conductors, terminate wires onto the termination apparatus in accordance with manufacturer's latest instructions.
  - e. For cable shields, terminate shield and drain wire onto the termination apparatus in accordance with manufacturer's latest instructions.
7. Termination Apparatus
- a. Provide accessories required for a complete installation.
8. Testing
- a. Perform post-installation testing as described in the Nurse Call Testing specification.
- E. IP integration
1. Coordinate the following items with network integrator:
    - a. TCP/IP address space and VLAN parameters
    - b. QoS requirements and configurations
    - c. PoE requirements and configurations
    - d. Servers, gateways, and appliance requirements and configurations
    - e. Firewall requirements
    - f. Network management integration
  2. Coordinate the following items with the wireless integrator:
    - a. Frequencies and channels
    - b. SSID



- c. QoS settings
  - d. Density requirements and concerns (Nursing stations)
  - e. Performance requirements
  - f. Roaming areas
3. Coordinate the following systems integration:
- a. Wireless phone integration
  - b. ADT/EMR
  - c. Middleware systems

### **3.4 LABELING**

#### **A. General Requirements**

- 1. Labeling, identifier assignment, and label colors shall conform to TIA/EIA-606-A and as approved by Owner's Representative before installation.
- 2. Labels shall be permanent.
- 3. Labels shall be machine-generated; hand written labels will not be accepted.

#### **B. Wire and Cable Labels**

- 1. Label Format:
  - a. Label type shall be wrap-around self-laminating.
  - b. Label color shall be white background with clear laminating window.
  - c. Text color shall be black; text height shall be 1/8" high, minimum, or #12 font size.
- 2. Provide labels on both ends of wires and cables. Fully wrap label around the wire insulation and/or cable jacket. Install labels no more than 4 inches from the edge of the insulation/jacket. Install labels such that they are visible by a technician from a normal stance.

#### **C. Station Labels**

- 1. Use labels included in the product packaging. For substitutions, request approval by the Engineer.
- 2. Label color shall be white.
- 3. Text color shall be black, 3/32" high, minimum, or #10 font size.

### **3.5 FINAL INSPECTION, START-UP, AND TESTING**

#### **A. Initial Punch Walk**

- 1. Execute an initial punch walk covering the Work of this Section, compliant to the requirements of Section 270511. Punch walk shall include installer's supervisor/foreman, prime contractor, Engineer, and (if applicable) Owner/Owner's Representative.

2. Schedule punch walk approximately 2 weeks in advance.
3. Plan initial punch walk with sufficient time to allow required adjustments.
4. Produce a list of corrections, repairs, and adjustments. Issue to prime contractor, Engineer, and Owner/Owner's Representative.
5. Complete the required corrections, repairs, and adjustments prior to System start-up.

B. System Start-Up

1. Upon completion of installation, 'start up' the System. A factory-trained service representative shall perform initial start-up.
2. Start up System prior to testing.

**3.6 BASIC TESTS**

A. Head-end Cabinets:

1. Confirm head-end equipment is powered from a dedicated critical power circuit
2. Confirm good earth ground connection
3. Confirm battery / UPS backup power installed

B. Patient Stations:

1. Activate patient call from bed cord:
  - a. Verify appropriate indicator lights on corridor light
  - b. Verify designated nurse master station sounds. Confirm room labeling and call type
  - c. Verify designated duty station sounds.
  - d. Cancel the call an the room station
2. Unplug patient call cord from bed station:
  - a. Verify appropriate indicator lights on corridor light
  - b. Verify designated nurse master station sounds. Confirm room labeling and call type
  - c. Verify designated duty station sounds
  - d. Cancel the call at the room station
3. Test audio communications (if optionally provided):
  - a. Place bed stations call
  - b. Answer call from nurse master station. Verify two-way communications
  - c. Cancel call
4. Repeat procedure for all patient call stations in room (i.e.; toilet, staff emergency assist, code, etc.). Not all stations have audio capability

C. Staff Stations:

1. Activate call from station:
  - a. Verify appropriate indicator lights on corridor light
  - b. Verify designated nurse master station sounds. Confirm room labeling and call type
  - c. Verify designated duty station sounds.
  - d. Cancel the call at the room station
2. Test audio communications (if optionally provided):
  - a. Place station call
  - b. Answer call from nurse master station. Verify two-way communications
  - c. Cancel call
3. Repeat procedure for other staff call stations for the room (i.e.; staff, staff emergency assist, code, etc.). These stations typically do not have audio capability

D. Duty Stations:

1. Activate call from station:
  - a. Verify appropriate indicator lights on corridor light
  - b. Verify designated nurse master station sounds. Confirm room labeling and call type
  - c. Verify designated duty station sounds.
  - d. Cancel the call at the room station
2. Test audio communications (if optionally provided):
  - a. Place station call
  - b. Answer call from nurse master station. Verify two-way communications
  - c. Cancel call

E. Bath / Shower / Tub Stations:

1. Activate call from station:
  - a. Verify appropriate indicator lights on corridor light
  - b. Verify designated nurse master station sounds. Confirm room labeling and call type
  - c. Verify designated duty station sounds.
  - d. Cancel the call at the room station
  - e. These calls can only be cancelled at the station initiating the call.
  - f. These stations typically do not have audio capability

F. Independent Code, Emergency, Assist Stations:

1. Activate call from station:
  - a. Verify appropriate indicator lights on corridor light
  - b. Verify designated nurse master station sounds. Confirm room labeling and call type
  - c. Verify designated duty station sounds.
  - d. Cancel the call at the room station
  - e. These calls can only be cancelled at the station initiating the call.
  - f. These stations typically do not have audio capability

**3.7 PERFORMANCE TESTS**

A. Servers

1. Confirm network connectivity
  - a. Validate assigned TCP/IP addresses - Ping, HTTP, NSLookup
  - b. Validate QoS tagging configurations - Inspect via a packet capture: Precedence & DSCP values
  - c. Validate access to Application gateways & servers
  - d. Validate access through security gateways (firewalls) by inspecting application logs and connection status
  - e. Validate Network Management configurations - Inspect SNMP community strings, passwords and traps. Initiate error state (example: unplug power supply, initiate test SNMP trap)
2. Confirm application connectivity
  - a. Validate any ADT/EMR connectivity - Demonstrate that Nurse Call system communicates with ADT servers/gateways and data is being transferred, this validation is application specific and needs to be coordinated with ADT/EMR support resource.
  - b. Validate any Middleware systems connectivity- Demonstrate that Nurse Call system communicates with any Middleware systems and data is being transferred. This validation is application specific and needs to be coordinated with Middleware support resource.
3. Confirm Audio Quality
  - a. MOS score of 3.6. Audio quality can be measured with an industry standardized Mean Opinion Score (MOS). This quantitative scale measures critical voice performance criteria such as delay, lost data, and jitter buffer loss that affect call quality in VoIP implementations. The MOS is expressed as a single number in the range 1 to 5, where 1 is lowest perceived audio quality, and 5 is the highest perceived audio quality measurement. Note that a higher MOS score indicates higher voice quality.
  - b. A MOS score should be calculated at the physical extremities of the network end points. For example: at the end of a wing or

remote building using the Nurse Call system. The data collection should resemble a typical call volume over a full 24 hour period.

- c. The MOS values are categorized as shown in the following table:

Measurement	Good	Acceptable	Poor
MOS	$\geq 4.03$ MOS	$\geq 3.60$ MOS	$< 3.6$ MOS
Delay (ms)	$\leq 150$ ms	$\leq 400$ ms	$> 400$ ms
Jitter Buffer Loss (%)	$\leq 0.50\%$ loss	$\leq 1.00\%$ loss	$> 1.00\%$ loss
Lost Data (%)	$\leq 0.50\%$ loss	$\leq 1.00\%$ loss	$> 1.00\%$ loss

- d. Packet delay from end point to endpoint should be less than 150 ms

- e. Jitter buffer loss should be less than 1%

- f. Packet data loss should be less than 1%

B. Battery Back-up Test:

1. De-energize main AC power source to the nurse call system (this test may be conducted with the system load test, below):

- a. Operate system for one minute beyond time for standby power to be energized (typically 70 seconds total)

- b. Confirm that calls (2 calls) are placed and responded to normally while system is on battery operation

- c. Re-energize AC power source

C. Fire Alarm Indication (this test may be accomplished with tests of the fire alarm system):

1. Activate a smoke detector:

- a. Verify appropriate indicator lights on corridor light

- b. Verify designated nurse master station sounds. Confirm room labeling and call type

- c. The indication will cancel when the smoke detector is reset

- d. This signaling is NOT intended to substitute for the primary signaling requirements of the Fire Alarm system and is intended only for auxiliary alerting to supplement the primary Fire Alarm system signaling.

D. System Load Tests

1. Activate 10 percent of the maximum number of stations that are connected to the nurse call receiving equipment for the zone to be tested. Verify that the system operates as intended

2. Activate a call. De-energize main AC power source to the nurse call system (this test may be conducted with the battery back-up test, above):

- a. Operate system for one minute beyond time for standby power to be energized (typically 70 seconds total)

- b. Confirm that there is no loss of patient calls. Emergency calls or code calls when the system is transferred to standby power or battery, and back
- c. Re-energize AC power source
- E. De-energize battery / UPS back-up. De-energize main AC power source to the nurse call system:
  - 1. Re-energize main AC power and battery / UPS back-up. Insure that there is no loss of any part of the integral nurse call configuration program required for normal functional system response.
- F. After completion of start-up and testing, thoroughly clean equipment, stations, etc.

### **3.8 ACCEPTANCE AND TURN OVER TO OWNER**

- A. Demonstration for Final Acceptance
  - 1. Execute a demonstration of the completed System to the Owner/Owner's Representative and Engineer, including presentation of the documented acceptance testing reports [see previous].
  - 2. Demonstrate to Owner and Engineer, at select locations, System operation and function, features, calling, alarming, interface with wireless VoIP system, interface with wireless paging system, and interface with RTLS system.
  - 3. Schedule demonstration approximately 2 weeks in advance.
  - 4. Should the demonstration fail, the Contractor shall bear all costs incurred by the Engineer and Owner for retesting and re-demonstration.
- B. Final Acceptance
  - 1. Issue to Owner record documents, per "Submittals" requirements.
  - 2. Only after complete and successful System testing, a successful demonstration, and accepted Record Documents submittal, the Owner shall issue written acceptance.
  - 3. At this point, the System shall be considered as turned over to Owner, and the warranty period shall begin.

### **3.9 SYSTEM TRAINING**

- A. Comply with training requirements of Section 270511.
- B. Provide training for Owner / Owner's representative. Factory-authorized service representative shall conduct the training. Schedule training approximately 30 days in advance. Training shall cover, at a minimum, the following:
  - 1. 40 hours of training for Nursing Staff, covering System interface and hands-on instruction of functions and capabilities
  - 2. 40 hours of training for Facilities Staff, covering System interface and hands-on instruction of maintenance and operation requirements

3. 40 hours of training for System Administration, covering hands-on instruction of programming, software, hardware, network interface, reporting functions, and other aspects of the System and its operation

### 3.10 EXTENDED SUPPORT SERVICES

A. Provide the following support services for duration stated under "System Description" following the Owner's acceptance of the System:

1. Routine Service: Provide "routine service" during business hours (9 a.m. to 5 p.m., Monday through Friday, excluding holidays). A service person shall be on site within <24 hours> of Owner notification. Events requiring routine service include a failure of minor equipment (peripheral equipment such as control stations, entertainment speakers, corridor lights, pull-cord stations, etc.) that would affect only one patient or patient room and would not compromise the System's operation.

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